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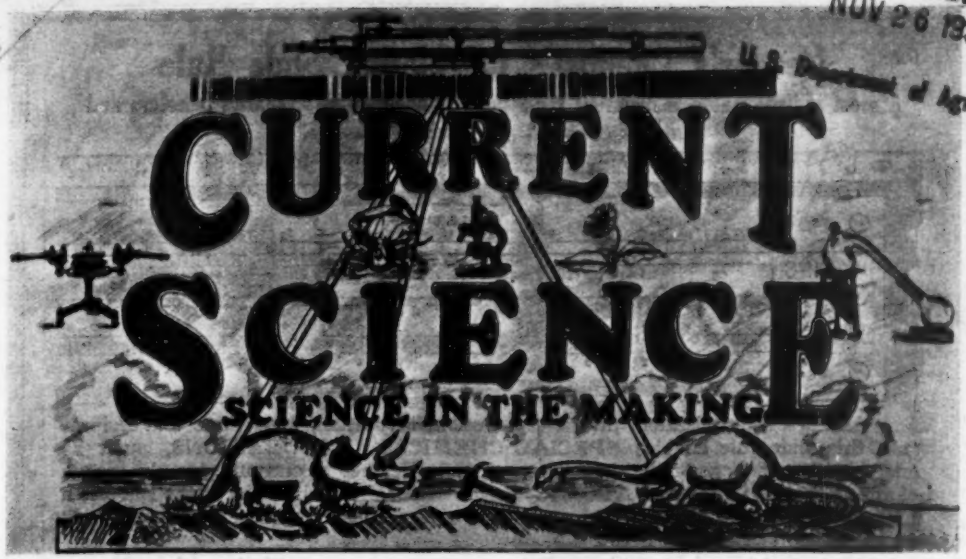


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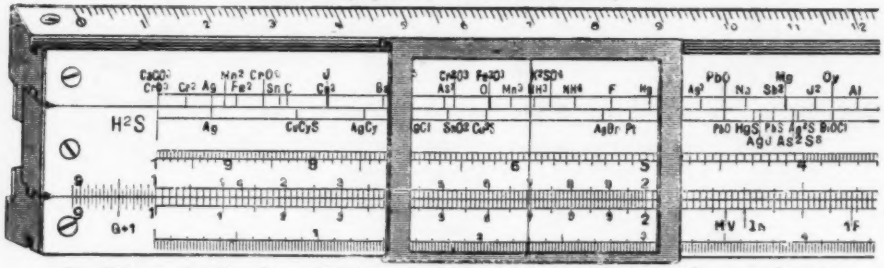

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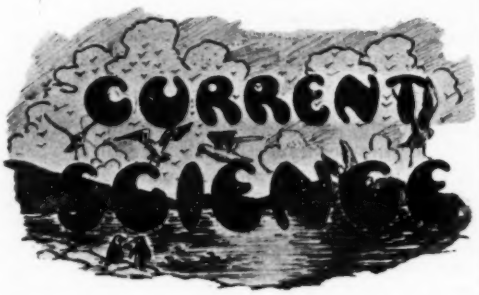


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## A Ten-Year Plan for India.

IN our editorial for the July number of *Current Science*, we indicated in broad outlines the main principles of a new educational policy which in our judgment is urgently called for and we described this policy as a Ten-Year Educational Plan. On 7th. September, the Associated special service announced in the press that a prominent Bombay businessman, Mr. Madhavji Govindji, speaking at a meeting held in connection with the Swadeshi Week, put forth a plea for calling "a conference of fifty Indian statesmen, an equal number of prominent Indian industrialists and as many scientists and experts for chalking out a Ten-Year Plan for India on the basis of the Five-Year Plan of Soviet Russia." He is further reported to have urged that, "the object of such a conference should be to formulate and work out a plan which would make the country economically free and self-sufficient within ten years", and that such a conference was "quite feasible and practicable". We are gratified that the project which we originally announced for the purpose of achieving certain definite results in the progress of education within a specific period, is receiving public attention. Indeed at the time we wrote about the educational plan, we were convinced that unilateral progress of a single department of public activity, would lead the country nowhere and that the time cannot be far off when it will be necessary to embark simultaneously upon a number of carefully considered projects of public utility, each having its own programme of action and achievement. In a series of articles, of which the present is intended to be a general survey, we propose to elaborate the details of some of the schemes which it is hoped will receive the due consideration of the Government and the people alike. Further in the formulation of any plan or programme which may have for its object the creation of a new and higher destiny for India, it must be borne in mind that a cheerful and sustained co-operation of the authorities and the leaders of public opinion, is absolutely indispensable. To a great extent the limitations imposed on such enterprises by the inadequacy of finance may be overcome by the initiative, organization and unremitting exertions of the people, but the most carefully thought out

plans, even if well-financed, will fail to achieve their purpose, if the country as a whole is not in a state of preparedness to receive and act on them.

Candidly we are not envisaging a Utopia. It is not maintained for a moment, nor even hoped, that within ten years, even if it were possible for all the projects to be worked simultaneously, with any degree of thoroughness and persistence, a complete transformation would be wrought in the economic, social, industrial and cultural life of this great sub-continent. It may not be extravagant, however, to suggest that under the continued stimulus of education and example, a large section of the Indian population towards the end of the period should be able to acquire sufficient initiative and enterprise to be able to work well, to eat well, to clothe themselves well and to occupy their leisure well. To a large extent, therefore, the ten-year plan, according to us, will be in the nature of exploratory work and in securing and organizing all the available resources for ensuring further progress in orderly and natural sequence. Both the Government and the leaders of public opinion may be asked the question, "What do you propose to achieve by pursuing the measures which you have respectively adopted?" The answer, "Peace and Order" on the part of one and, "Political Freedom" on the part of the other, must be imperfect to a degree, for neither can be regarded as an end in itself. Each is only a means for higher ends. Have the authorities and the peoples' representatives any programme of national reconstruction which they intend to carry out after securing the means which they have set their hearts to compass? It seems to us that they, having caught hold of the wrong end of the plough, are guiding its share along barren furrows for a crop of dead sea fruit and India would be a perfect paradise to live in if they both, who profess sympathy for the people, were to pool their resources and work in mutual trust and harmony for the advancement of the country. The idea of a ten-year plan for India may be a modification of the Soviet programme, but the schemes we have in view differ both in their object and in the methods by which it is to be attained. In referring to the tyranny of the machine, Sir Alfred Ewing in the concluding portion of his presidential address to the British Association which recently met at York, is reported to have said the following in connection with the Russian Plan, "The Commissar lays down dates for the delivery of specified quantities by each factory and invests twenty-one special directors with extraordinary powers to increase production, threatening each director with personal punishment if deliveries are belated." The construction of the Dnieper dam and the hydraulic works which formed part of the Soviet Five-Year Plan, must have proceeded on the same method of enforcing labour under threats of personal punishment; but it must be obvious that any plan whose beneficence may be as wide as humanity itself, is bound to collapse the moment the external pressure, which is its motive, is withdrawn. Coercion of labour even in the name of the peoples' emancipation must in every respect be opposed to political ethics and must be a negation of personal freedom for the attainment of which all constitutional agitation is directed.

Our ten-year plan is intended to implant in the mind of the people the recognition of work as joy and virtue and the sense that spontaneity in co-operative endeavour for their economic uplift and the higher standards of civic life, is the essence of a dignified national existence. The urgency and magnitude of the task involved in carrying out any programme of social reconstruction calculated for the betterment of the people ought to be sufficient inducement for the restoration of normal conditions of public life in the country. The genius and the vast resources of the Government and the people, without being further permitted to expend themselves in a game of out-manœuvring each other, should be unreservedly devoted to the promotion of those schemes which would lead to the evolution of a higher civilization, a thing of which India is still capable. It is true that during the past century India has achieved greatness and it must be gratefully acknowledged that such progress in education and other departments of public utility as has already occurred, is due mainly to the efforts of Government. But the tardiness of the process of development must be due to a variety of causes, among which the most potent are the limitations of finance and the unpreparedness of the country. It is the purpose of the plan to be suggested by us, to remove these major obstacles and clear the ground for continued and concerted action for the achievement of definite results in national welfare. In this process the people

ought to realize that their higher destiny can only be their own handiwork and that in its attainment, honesty and sincerity of purpose are as vital as cheerfulness and steadiness of co-operation. The task of the Government and leaders of the people will be to initiate, organize, direct and control this great nation-wide movement of social and political reconstruction.

The problem which it will be the concern of the ten-year plan to advocate, presents in the main a three-fold aspect, material, intellectual and moral advancement, none of which, in our opinion, can be treated as a water-tight compartment, capable of being taken up for consideration one after the other. These aspects are closely interdependent and a general campaign therefore for their uniform advancement must constitute the programme of the plan. It should be realized that the fundamental object of spreading education among the people is to enable every individual to discover to himself the talents which he can turn to the most stern account, to know and to practise that truthfulness and honesty of work must be the basis of all business transactions and to love and to serve one's neighbour is the condensed summary of all ethics and religion. People are slow to recognise that ignorance and slothfulness are an offence to themselves and a source of danger to the stability and progress of the society to which they belong: and without contributing to their elevation, will only tend to depress both by sapping their very substance. Through launching an active educational campaign, a steady and continuous advancement along three fronts is hoped to be achieved.

We shall briefly summarise the directions in which we believe that the reconstruction project should be carried on. A little reflection will make it clear that the first step is to mobilise all possible and available resources to accelerate the growth of material production. It stands to reason to suppose that a rapid output of industrial and agricultural produce is the primary condition for raising the material standard of life of the people. In order to do so, the first step ought to be to extend such of the factories and agricultural concerns as exist at present, to equip both with modern machinery, to build new factories and bring every inch of waste land under cultivation by an extended and comprehensive system of channel irrigation. It is well known that an increased output of labour implies improvement of methods of labour in general, and of skill and training of individual workers. Generally the workers in factories and agricultural pursuits are drawn from the rural population whose education and technical equipment amount at present to very little. They are saturated with antiquated and, in many cases, with traditional habits of work and their apathy towards progressive and scientific methods is almost proverbial. Consequently the first few years of the plan will have to be devoted to the problem of producing a new class of men, whose level of education and wider outlook will make them receptive of progressive ideas calculated to lift them into a higher plane of existence.

In order to transform the existing major industries so as to put them on to a higher technical basis and to found new ones, it becomes necessary to establish the closest possible connection between science, technology and production and to bring scientific work into intimate association with the solution of industrial problems, including transport and agriculture. All this is to be taken in hand in the preparatory stage which is also devoted to the improvement of the culture of the people and in fact educational development of the masses must synchronise with the industrialization of the country. The cultural work must be based on some form of compulsory popular education which will guarantee the advancement of the people, for this advancement implies the disappearance of illiteracy, improved technical training, and a progressive spirit. Then there is the question of rapidly training a competent and reliable band of young engineers and technicians from the ranks of the village population, which must necessarily involve the raising of the level of technical education in the rural areas.

We can hardly think of elevating the life of the people in any of its aspects without introducing at the same time some form of compulsory education in the country and it is doubtful if the cost of establishing compulsory free schools for an enormously large population like that of India, could be borne by the nation, without a portion of it being defrayed by the increasing output of industrial concerns. Here is an eternal tangle, whether educational expansion is to precede or to follow industrial development. In 1930, according to official statistics, the percentage of total scholars to the total

population was 5.1, which represents an increase of 0.2 over that of the previous year. In the same year out of a total of 9.22 million pupils undergoing instruction in the primary schools, only 1.32 millions went to the middle schools and 9.22 lakhs were found in the high schools and 9 02 thousand entered the university. These figures give an impressive idea of the wastage of pupils in every grade of education and the appalling waste of public funds on the so-called education of 8 millions of pupils who simply lapse into illiteracy again. Looking at the spread of education among the different communities, we discover that the percentage of pupils to the total of the Hindu community is 4.8, which is 0 6 per cent less than the Muslims and 17.4 per cent less than the Parsis and yet the Hindus form the major community of the total population. The average annual cost of educating a pupil is about Rs. 23-0-10 and of this amount nearly Rs. 20 brings little or no return to the expending authorities, on account of the wastage of pupils in the successive stages of their educational career. Without entering into the subject of industrial and technical schools, we have stated the problems arising from a perusal of the official documents relating to general education and we are struck by their formidable nature as soon as we try to find anything approaching a satisfactory solution under a ten-year plan. If we can devise means for preventing or minimising the volume of lapses into illiteracy, we shall consider ourselves as having offered a helpful suggestion to the promotion of education among the people of India. These problems and others directly or indirectly related to education, such as those pertaining to the industrial, economic, social and political life of the country, will be dealt with in our columns as time and space permit.

The cardinal point of our contention is that progress in any department of public activity should not be the outcome of mere accident or haphazard policy, but should be the result of pursuing a specific and carefully worked-out plan spread over a definite period of time. To ensure the success of such plans, the movements must spring from the heart of the people and must not be imposed on an unwilling and untrained populace. On the other hand, the authorities and well-to-do classes will have to realize sooner or later,—the sooner the better,—that they will be able to maintain for themselves the means of living in comparative opulence, leisure and comfort, only if the masses also are placed in a position to enjoy such a life at least in a small measure. The Earl of Oxford once declared of England that, "The course of our constitutional progress has been in the main not an alternation of revolution and reaction, but a course of more or less even development." We are of opinion that the progress in the spheres of human activity with which we propose to deal, should proceed uniformly and rapidly along the lines of equally "even development" and we propose to base our suggestions for a ten-year plan on this most acceptable and wise doctrine.

## The Indian Institute of Science, Bangalore.

IT will have been a cause for general satisfaction among the Indian community of science to learn that Sir C. V. Raman has been appointed to the Directorship of the Indian Institute of Science, Bangalore, which becomes vacant early next year by the retirement of Dr. M. O. Forster. The occasion is a suitable one for reviewing some historical aspects of the Institute and forecasting a few developments which may be anticipated.

Since the opening of the laboratories in 1911, the Institute has always been a subject of considerable interest to the general public, which from time to time has offered advice directed towards improvement of its service to India. Such advice has not invariably taken the form of constructive criticism, because its authors have not sufficiently realized that a new institution, entirely novel to the country and therefore without a fund of experience on which to draw, must pass through an exploratory period of development before a recognizable tradition emerges. That stage having now been reached, however, the following observations may perhaps be regarded as timely.

Early expectations of revolutionary improvement in scientific industry and spectacular development of new industries, having been based on imperfect appreciation of the factors involved, were not fulfilled. Twenty years ago it was not generally realized that although laboratories for training students

in the scientific principles underlying industrial processes and in the methods of scientific research may be the cradle of a new industry, they cannot carry the infant enterprise beyond a very elementary stage. Higher authorities concerned in establishing the Institute were very definite on this point, however, as appears from a resolution by the Government of India in this matter, dated 27th May, 1909. During the discussion then prevailing, Government "were of opinion that the idea of combining in one institution, and entrusting to a single staff of professors, both the teaching of science and the experimental development of new industries, was open to the obvious criticism that these two objects were in no way connected with one another." Moreover, the two educational experts finally deputed to frame a scheme recommended "that the Institute should be devoted to experimental science, and should aim at training students in experimental methods, carrying on original research, and discharging the functions of an accepted authority and referee on all scientific problems within its own domain."

Furthermore, it is evident that these higher authorities appreciated the tentative aspect of the plan then to be launched, because in the concluding passages of the Resolution above quoted, the Governor-General in Council realized, "that the results of the experiment that is now about to be tried will depend less upon the conditions of the project itself than upon the character and energy of those who may come forward to take advantage of the facilities for advanced studies which it will offer." Finally, the Vesting Order founds "an Institute of Research in India" and the attached scheme of administration inculcates "the promotion of original investigation in all branches of knowledge and their utilization for the benefit of India," without specific mention of industrial activities.

Reflection on the cultural principles involved will tend to confirm the opinion of these authorities. If the training of students in methods of inquiry is to be the primary object of an institution—and the above quotations clearly establish that intention for the Institute—it is necessary that the subjects selected should have instructional value, and outside the factory itself such subjects are less commonly found among the class of problems arising from industrial processes than in the academic field. For example, a student might easily spend two years in trying (successfully or unsuccessfully) to raise by 5 per cent. the yield of a chemical product, without gaining much insight into the technique of chemical research: whereas, on the other hand, a well-chosen academic exercise may in the same period equip him with the mental machinery for solving many problems quite alien to the one he did solve. Moreover, modern industrial research has long passed beyond the stage when a lad of eighteen, trying to synthesise quinine, can stumble on mauve and then, by an amazing exertion of skilful diligence and the loyal support of his relatives, proceed to found a colossal new industry. The successful application of science to manufacture nowadays depends principally on team work by highly trained men, temporarily freed from the necessity of equipping themselves with further technical qualifications and then seeking employment. Those who think otherwise may profitably study *Searching into the Unknown*, by the General Electric Company, Schenectady, N.Y.

Nevertheless it is apparent that those responsible for developing the resources of the Institute, while placing in the foreground the requirement to impart advanced knowledge, and instruct in the methods of research, have consistently kept in mind any possible bearing which the results may have on the inception of new industries and the improvement of existing ones. Ample evidence of this recurs each year in the appendix to the Council's report, showing in abridged form the current subjects of investigation; but although the technological application of the work at the Institute has been wide, and in several cases valuable, there is doubtless room for expansion in this field. As pointed out by the Quinquennial Reviewing Committee, there should be close collaboration between the Institute and the Scientific Surveys, the Telegraphs Department, the Meteorological Department, the Railway Board, Chambers of Commerce and the Directors of Industry throughout India. Association with these entities does occur, but it has not resulted in many problems being referred to the Institute.

Most of the subjects with an economic application latterly engaging the attention of the Institute have in fact been initiated therein, as instanced by the systematic inquiry into the cause of spike-disease in sandal. This has now continued during the past five years in co-operation with the

Government of Madras and the Coorg Commission, the results being summarized in periodical reports published separately from the Journal of the Institute. The latter publication contains a description of the various inquiries, academic and economic, which have been pursued in the laboratories and in the past fifteen years has comprised about 200 issues. The range of subjects is wide, and includes many that might be turned to an industrial utilization of principles or materials. This aspect of the work is reflected in the fact that the major proportion of the Institute's former students have been absorbed into non-academic occupations, particularly in the field of electrical technology. The development of this department has been very notable, both in heavy electrical engineering and in the section of electrical communication; and in this connection it may be explained that the primary object of the department has been to provide advanced courses of instruction supplementary to those obtainable in the universities and engineering colleges. Hitherto, the facility with which students trained at the Institute have gained employment in the rapidly growing electrical industries has disinclined all but a small proportion to prolong their sojourn at the Institute for the purpose of research.

The main object for which the Institute was founded, as defined above, is being steadily enlarged. Fifteen years ago the number of workers in the various departments was 41; during the year lately closed the corresponding total was 142. In the same period the strength of the staff has grown from 9 to 26, and it is noteworthy that of this number 19 are former students of the Institute, thus fulfilling one of the most earnestly cherished wishes of the late Founder, Sir Dorabji Tata. Out of all proportion to the growth in the number of students has been the increased aid rendered annually in the form of scholarships, etc., which has expanded from Rs. 4,700 to Rs. 53,800, while expenditure on working and equipping the laboratories has trebled, being Rs. 65,100 against Rs. 22,600. Fifteen years ago the outlay on periodicals and new books was Rs. 2,100, while to-day it is Rs. 16,000.

Although this chronicle of development suggests that the financial position of the Institute is reassuring, there are some features of instability to which attention should be drawn. Sir Dorabji Tata's hope, shared by all those who have the progress of the Institute at heart, was that it should become an all-India institution. In the sense that its students are drawn from almost every part of the sub-continent the hope has been realized with this reservation, that for geographical reasons a largely preponderating number is received from Mysore and Madras. It is regrettable, however, that this all-India feature is not reflected in the sources of revenue. Among these the return on the original endowment with interest on savings and the annual subvention by Government of India represent 88 per cent. of the total, and the major portion of the remainder is contributed by the Government of H. H. the Maharaja of Mysore, which has generously granted Rs. 50,000 per annum hitherto, in conformity with a promise made when Bangalore was finally selected for locating the Institute. From this it follows that, excepting Mysore and Hyderabad, which also has uniformly and generously supported the Institute, contributions from States and Provinces have been disproportionate to the benefits received by their students. For example, although during the past six years the numbers deriving from Mysore, Madras and Bombay have been approximately the same, with a distinctive advantage in favour of the two last named, the respective contributions have been Rs. 50,000, Rs. 5,000 and nil. This discrepancy calls for rectification, on grounds both moral and material. In the first place, absence of support from Bombay and Bengal may be used by other regions as an excuse for withholding assistance, or for reducing such aid as may be given already, and secondly, the revenue of the Institute has remained for some years stationary, and at the moment is declining.

Accordingly, it is necessary that wider resources become available, and without undue delay. With this provision the future, to which we now look for progress and expansion at least comparable with those of the last fifteen years, is full of hope. This is not the place in which to panegyrise the scientific achievements of Sir Venkata Raman. These have not remained in obscurity, and they give promise that the Institute, without in any way diminishing its interest in possible industrial applications of its work, will add to its academic resources a department of physics as a link between existing activities in physical chemistry and electrical technology.

ALCHYMIST.

## Unemployment in India.

SIR M. VISVESVARAYA'S thoughtful address[1] before the University Union, Bangalore, has provoked a considerable amount of fresh interest in this "Master Problem" of the age and, as mentioned in our previous number,[2] we take this opportunity to discuss the subject, in greater detail, in the light of the valuable suggestions made by that veteran statesman.

A critical study of the various causes which led to the present situation would show that, although the world-wide economic distress is partly contributory to increasing unemployment, the main causes are deep-seated and inherent to the conditions prevalent in India. Among the latter may be mentioned, (*a*) the disproportionately rapid growth of population in comparison with the limited resources of the country, (*b*) unbalanced occupational structure arising from neglect of industries and overcrowding on land, (*c*) want of adequate efforts on the part of the Government to encourage industries and to explore new avenues for increasing employment, and (*d*) certain defects due to faulty traditions of the people and disabilities arising largely from the trade policy and other similar measures pursued, for a long time past, with regard to the country.

During the past few years, the trade returns of the country have diminished considerably while the population has greatly increased. The birth rates are now far higher and the average income considerably less than those of most European countries, so that the standard of living has gone down with increased poverty and misery all round. According to certain thinkers, restriction of population has now become a necessity and it is pointed out that birth-control measures so successfully practised in all civilized countries should be adopted more extensively than in the past.

This view may not be shared by a certain section of the public, but, considering the already under-nourished condition of majority of women and children and the fatal consequences of frequent motherhood, it must be admitted that some voluntary type of birth restriction is in the opinion of these advocates needed to improve the general condition of, at any rate, a great majority of the population.

As Sir Visvesvaraya pertinently points out, the pressure on land has lately increased considerably without any appreciable improvement in output; indeed, recent statistics show that the total area under cultivation has appreciably diminished during the past few years. The above are largely due to (*a*) the agricultural population having increased out of all proportion with their earning capacity and (*b*) decreased foreign demand for Indian agricultural produce. Many of the countries that were once buying from India are now either raising the required articles or their substitutes in their own countries or are buying them from cheaper rivals. Although our cost of production is lower than those of most other countries, we lack cheap transport facilities and requisite organization for collecting and disposing of produce so that we are unable to compete with our rivals and are thus steadily losing ground on foreign markets. The majority of the agriculturists themselves are not, however, aware of this situation and early steps should be taken to educate them to their position and to stimulate co-operative effort to reduce the cost of production, improve the yield, pool the produce and organize internal as well as external trade.

So far, the main occupation of the majority of the population consisted in the production of raw materials for food and clothing which were disposed of, as such, to the buyers in the country and abroad. Except in textiles very little effort has so far been made to convert the produce into more valuable finished articles. As mentioned in a previous number,[3] the majority of the articles that contribute to human comfort and well-being are derived from agricultural produce and well placed as we are with regard to cheap man-power, a considerable portion of our future efforts should be directed towards the promotion of industries relating to the utilization of agricultural produce. Such a policy which requires the active support of the Government would not only relieve congestion on land but also stimulate output from the soil.

Although agriculture is the basic industry of the human race, it is yet a precarious

[1] Now published as 'Unemployment in India: Its causes and Cure', Bangalore Press, Bangalore (1932).

[2] *Cur. Sci.*, **1**, 60 (1932).

[3] *Cur. Sci.*, **1**, 30 (1932).

means of livelihood and the experience of the more progressive countries like the United States, Canada, Great Britain and Japan show convincingly that industrial development is absolutely essential to ensure the prosperity of a nation. The industry of to-day connotes imagination, organization and enterprise, the key to all worldly comforts that make life worth while; it is the very breath of civilization and the sign of modern progress. It need, therefore, be hardly urged that efforts of the Government as also of the public should be directed towards the promotion of industries and encouraging native enterprise.

About a century ago India exported cotton, textiles, steel and sugar to Europe, but now she is importing the same products from abroad and paying for them between 50 to 70 crores of rupees per annum. The ancient arts and manufactures which were once the pride of the Orient have steadily passed into decay while the policy of free trade and the system of internal taxation adopted in the past facilitated the unrestricted dumping of foreign produce resulting in the extinction of initiative in the people. Even to-day, the Development Departments of the different provinces as also the Department of Industries and Commerce of the Central Government are not in a position to render much assistance towards the promotion of new industries. The provincial departments have very little money for nation-building activities while the Imperial Government confines its interests to the publication of bulletins of general information. The latter are, no doubt, useful but they should provide fresh ideas with regard to possible future developments if they are to materially assist the industrial development of the country. In all the progressive countries new industries have generally originated from active co-operation between the Government on the one hand and the technical men and business magnates on the other; in the early stages, at any rate, the necessary tariff protection is afforded and material assistance rendered to facilitate the perfection of the related processes. India should adopt a similar policy if she is to make any headway as a manufacturing nation.

While the best energies are required in other directions, it is indeed highly deplorable that a considerable amount of national talent is being frittered away in wasteful pursuits. The majority of the moneyed classes do no work at all: nor do they have the ambition to improve their resources by assisting productive ventures. Almost the entire population of women—particularly the married ones—have no useful occupations. There are a number of minor and even major industries to which women, working in their homes, can render considerable help and, at the same time, receive useful remuneration that would materially add to their resources. We do not, however, think that the time is yet ripe for women to compete with men in the regular services, but may well hope that with increased industrial development there may be employment for all available talent in the country.

Unemployment among the educated classes is far more distressing to-day than that among the others. The majority of the former are derived from the lower middle classes of the country who have staked their modest means to qualify for livelihood, but their object is not to be attained. There are thousands of graduates—not to mention the larger numbers of less qualified persons—who have received high liberal education which has given them the valuable intellectual outlook but not the practical insight that would provide means of independent livelihood. Our present system of education, though praiseworthy in other respects, does not qualify men and women for the business of life and it is high time that drastic reforms were introduced making the higher training largely vocational and extending the instruction to scientific agriculture, engineering, chemical technology and higher commerce. An immediate difficulty in the perfection of the above scheme is the finding of men and women with the necessary practical experience to train others; but considering that other countries had to begin the same way, it is not too much to expect that with the changed outlook and adequate encouragement the required type of talent would soon be available.

Adult education would no doubt be of considerable value in both urban and rural areas but it would not prove to be of much assistance unless the training is so directed as to improve the earning capacity of the people. Efforts should be made to establish experimental night schools whereat free training will be imparted in the best ways of conducting business or agricultural operations. The teaching could be done by men and women with commercial or agricultural training who may be paid small honoraria for doing the work. In this, as in other

things, the initiative should come from the Government. Sir Visvesvaraya lays the necessary stress on the need for rapid industrialization and makes valuable suggestions for the organization of small, medium or large scale industries. We are, however, rather diffident about the working of some of them at any rate under the Indian conditions. Thus, although it is highly desirable to have co-operative ventures in rural areas it would require more than ordinary effort on the part of an organizer to keep the community together. Moreover, the people will have to pass through years of training before they could be brought to appreciate the need for such organizations. On the other hand, if capable organizers with the single objects, such as, say preparation of nitre or manufacture of fruit syrup as determined by the facilities of the place, should get the work done by a representative section of householders who would receive payment for the work, then that will prove an incentive for the others to follow.

With regard to the organization of medium and major industries, the information at the disposal of the chambers of commerce or industrial organizations is hardly sufficient for starting such ventures. Past experience in inviting outside experts for short periods to initiate new industries has also not been very happy. The experts are naturally reluctant to part with all their knowledge as that would be the very undoing of their own positions.

To our mind, the best means of initiating new industries is through the organization of a fairly stable *Development Commission* as in the case of Great Britain or Australia who would first tour the country, meet the representatives of technical sciences, agriculture, industries and commerce, study the various possibilities first hand and with the co-operation of small expert committees, prepare systematic plans of industrial undertakings. The related processes may then be worked out, on small scale, either at some central research station which would be directly under the Commission or, preferably, in private institutions aided by the Commission. The Commission as well as its expert Committees would keep in continuous touch with the developments and issue periodical bulletins of progress for the information of the public. When the experimental stage is passed, the Commission should invite interested business men to try out the results on semi-commercial scale, the cost of the trials as also the salaries of the technicians conducting the work being borne by the Commission so that the feasibility of the processes may be fully demonstrated without any expense to the interested bodies. Once that stage is reached and the processes have proved successful, the Commission should relax their interest so that private enterprise may have scope to do the rest. They should, no doubt, hold themselves in readiness to assist in the solution of further problems arising in connection with the same and related industries, but beyond defining the fundamentals they should leave all developments to private enterprise. In addition to initiating new industries, the Commission should also keep in touch with similar organizations like the Imperial Council of Agricultural Research, the Indian Research Fund Association, the Indian Institute of Science, the Zoological, the Geological and the Botanical Surveys of India so that they may have information from all points of view before undertaking even their experimental ventures.

It may be suggested that the Commission should include at least one technical chemist, an engineer, an industrialist with experience in organization and a business man with sound knowledge of trade in India and abroad. All the members of the Commission should have thorough knowledge of the country and its resources. They should be appointed, preferably on the contract basis, for periods of say 5 years at a time with the stipulation that they should not possess any private consulting or other business interests, at any rate, during the term of office. The Commission as a whole should be independent of the Government though assisted by it. They should have the power of augmenting their resources by receiving subsidies or donations from Native States or philanthropic individuals, but they should not receive any assistance from private commercial interests.

The above scheme could be elaborated still further but the present is hardly the occasion to do so. It is, however, sincerely hoped that the attention of the Government as well as the leaders of the public would be drawn to the thoughtful utterances of Sir M. Visvesvaraya so that India which will soon receive a large measure of self-government, may also be alive to the importance of economic freedom which is the key to the solution of unemployment.

# Development of Pharmaceutical Industry in India.

By Dr. M. C. Tummin Katti, Ph.D.,

*Indian Institute of Science, Bangalore.*

DURING the last few years with the spread of the spirit of *Swadeshi*, the demand for Indian-made goods has been gaining considerable ground in this country. Consequently, a number of new industries wherein the resources of the country can well be utilized, have sprung up recently. Certain industries like the textiles, soaps and a few others have advanced far enough and it can be said with a certain amount of confidence that if necessity arises, India can meet her own demands for the products of these industries, while pharmaceutical industry, in spite of the plentiful source of a number of raw materials, is still in an infant state. Perhaps one may account for this by saying that comparatively a very small percentage of the people in this country have acquired the habit of using allopathic medicines. Still one would be surprised at the vast amount of money spent in importing these allopathic medicines from foreign countries. Statistics for the last five years show that India imports annually drugs and medicines (excluding chemicals) worth about two crores of rupees.

In dealing with the development of the various aspects of the industry, it is essential in the first place to discuss some of the serious difficulties which this infant industry in India is facing to-day.

The most rigid and inconvenient excise regulations form one of the serious difficulties in the way of the development of the Indian industry. Hindrance to the free movement of alcoholic preparations in inter-provincial trade due to diverse excise regulations in different provinces, restrictions to the use of duty-free alcohol for manufacturing purposes and comparatively high cost of maintaining a bonded laboratory and a warehouse for the manufacture of alcoholic preparations are among the chief difficulties arising out of excise regulations.

Paucity of reliable crude materials is another serious difficulty. Although crude vegetable drugs are available in plenty, there are no reliable dealers who can supply the manufacturers regularly with medicinal herbs of the proper quality. This is partly due to the ignorance of the people who collect the drugs from forests without taking any special care to avoid the decomposition or the destruction of active principles, and partly to the general tendency to adulterate such drugs. In the absence of any definite law in the country prohibiting the manufacture, import or sale of adulterated or inferior quality drugs, unhealthy competition has made it extremely difficult for manufacturers of drugs of standard quality to compete with those, who, whether foreign or local manufacturers, do not hesitate to sacrifice quality, or resort to adulteration to satisfy the popular demand for cheap medicines. In addition to these, lack of cheap transportation facilities, excessive tariff on the import of crude drugs not available in India and the absence of scientific research along pharmaceutical lines are among the other factors which hinder the development of the industry in the country.

For the purpose of discussion pharmaceutical industry in India can be roughly divided into five parts, namely, the manufacture of

(1) spirituous galenicals, such as, tinctures, extracts, etc.,
(2) biological substances, such as, vaccines, sera and glandular products,
(3) active principles of vegetable drugs, such as, glucosides, alkaloids, essential and fixed oils, etc.,
(4) pure organic and inorganic medicinal chemicals,
(5) and lastly, the cultivation, collection and further preparation of crude botanical drugs.

(1) This is the branch to which most of the Indian pharmaceutical houses are confining their activities, partly on account of the comparative simplicity of the machinery and the process of manufacture and partly on account of the availability of almost all the raw materials in this country. There seems to be, therefore, no reason why practically all our requirements pertaining to such preparations should not be manufactured in India. With a little more sympathetic attitude on the part of the excise department and an earnest attempt on the part of the growers and collectors of crude vegetable drugs to supply materials of proper quality there seems to be no difficulty in the development of this part of the industry.

(2) The most important requirement for the manufacture of products under this division is the availability of sufficient raw material of suitable quality. The large number of slaughter houses will provide raw material which is at present wasted and certain local conditions such as the comparative freshness of the raw material, the animals living in the local environments and the utilization of local strains of organisms have the added advantage to the Indian manufacturer. Although certain Indian manufacturing houses are successfully manufacturing biological products, it is a matter of doubt whether these will eventually be able to successfully compete with American or European manufacturers. The latter have the great advantage of easy access to suitable raw materials from their well-organized meat-packing industry. Furthermore, with the inherent non-violent nature of the average Indian, it is highly doubtful whether it will be possible in the near future to develop cattle-breeding as an industry with the ultimate object of utilizing such cattle for the manufacture of glandular and similar biological products. So far sera and vaccine are concerned there are no such serious difficulties in the way.

(3) Except the manufacture of quinine in the Government factories at the Nilgiris and Darjeeling and in one or two private factories, not much manufacturing is done in India along the line of preparing active principles from crude vegetable drugs. India is the principal source and in some cases the only source of many vegetable crude materials from which active principles like alka-

loids and glucosides are manufactured. If the excise regulations are liberalized many products like santonin, strychnine, berberine, caffeine and atropine and many essential and fixed oil medicinal preparations can be easily and economically manufactured in India.

(4) Since the World War organic chemistry has made tremendous progress in the domain of synthetic medicinal compounds. The manufacture of such substances in India at the present state of her industrial position is, however, confronted with many difficulties. The most serious of such difficulties is the lack of a well-established chemical industry in the country. Although a few organo-metallic compounds like urea-stibamine are manufactured in India, this branch of the industry cannot very well succeed unless a general all-round development of the chemical industry takes place in the country.

(5) This part of the industry has not received as much attention in this country as it deserves. We have been so far relying entirely on the natural resources of the country. In order to make India self-sufficient and to supply raw materials of known and good quality to manufacturers, it is essential and desirable that cultivation of medicinal plants is thought of more seriously. India possesses varying climatic conditions. It is, therefore, possible that medicinal plants which are not growing within her boundaries may be made to do so. Thus cultivation applies not only to such plants but also to those growing wildly in a scattered condition. In the case of the latter it more often happens that the cost of collection and transportation becomes extremely heavy when we consider the high railway freight charges in the country. In advanced countries like Germany, England, United States of America, Belgium and France, medicinal and essential oil plant cultivation has proved a great success. Attempts in this direction are now being made in certain parts of Northern India. The Government of Kashmir, in addition to careful tapping of vast resources of their forest, are making earnest attempts to cultivate some very important drugs. The U. P. Government has also taken keen interest in this problem as part of their programme for agricultural development of the province.

Pharmaceutical industry like many of the highly technical industries requires the help of men of scientific attainments and expert knowledge. A number of problems connected with the various aspects of the industry discussed above need the services of various scientific men. A large number of vegetable drugs used medicinally in India still await chemical and pharmacological examination on modern lines and some of these at least, on careful study, may prove very good substitutes for the foreign costly drugs imported now. Methods of preservation of various galenicals under the Indian climatic conditions will have to be worked out. Processes for the isolation or extraction of active principles from the drugs already investigated will have to be devised. Optimum conditions will have to be found out for the successful cultivation of many drugs now growing wildly or acclimatized.

There are other equally important problems which even a scientist interested in pure academic research can help the industry. One of the serious difficulties in the way of a healthy growth of pharmaceutical industry in India is the problem of gross adulteration of crude and finished medicinal substances. This situation has become so acute that the Government of India appointed a Drugs Enquiry Committee in August 1930 to "enquire into the extent to which drugs and chemicals of impure quality or defective strength, particularly those recognized by the British Pharmacopœia are imported, manufactured or sold in British India and the necessity in the public interest, of controlling such importation, manufacture and sale and to make recommendations."

The Committee met, toured all over India, made an exhaustive enquiry and the findings and the recommendations of that Committee are embodied in the report published last October (1931) by the Government of India. The Committee have recommended certain ways and means of combating this evil of adulteration. Among many important suggestions, recommendations have been made for the enactment of a Drugs and Pharmacy Act and in order to enforce the provisions of such an Act, the compilation of a standard authority like the Indian Pharmacopœia.

For the moment the provisions of the Act may be left out of consideration; only the compilation of the Indian Pharmacopœia needs to be considered as far as scientists are considered. Methods of identification including chemical and biological assays of various botanical drugs and their preparations will have to be standardized. Very delicate methods for the isolation, identification and estimation of various adulterants will have to be devised. It is not very difficult to imagine the up-hill task of the Indian scientist when the inclusion of a number of indigenous preparations in the Indian Pharmacopœia is proposed. However, when the passing of the Drugs and Pharmacy Act becomes an accomplished fact and the best scientific brains of the country are called upon to share the responsibility of compiling the Indian Pharmacopœia, let us hope that the Indian scientists will not be lacking in their efforts to accomplish such an end.

Considering the situation of the various aspects of the industry as a whole, one can say with a certain amount of confidence, that, in spite of the serious handicaps an infant industry has to undergo, there is still wide scope for the development of the pharmaceutical industry in India. There are enough raw materials available; a large portion of the machinery can be manufactured in India; there are certainly scientifically trained young men who are willing to undertake the work if sufficient encouragement is given. There are not many insurmountable difficulties. On the other hand there is everything in favour of such an enterprise. The consumer will be enabled to get really potent preparations probably at less cost. A new industry with great potentialities will be started and finally an opportunity will be provided for harnessing the Indian talent for chemical and biological research.

## Letters to the Editor.

### Grammatopteris, a Link between the Osmundaceæ and Zygopterideæ.

THE well-known theory that the Osmundaceæ and Zygopterideæ arose from a common stock was one of the main results of Kidston and Gwynne-Vaughan's classical work on the Fossil Osmundeceæ.[1] This view was based chiefly upon a comparison of the genera *Thamnopteris* and *Zalesskya*, both from the Upper Permian of Russia, with certain Palæozoic Zygopterideæ. It is unfortunate that during the life-time of these authors the Lower Permian genus *Grammatopteris* of Renault[2] was only very imperfectly known; for, as they acutely suggested in 1907, this genus "possesses a type of structure that may be regarded as primitively Osmundaceous".[3] In 1918 the present writer ventured the opinion that in rocks older than those which have yielded the most primitive known Osmundaceæ (*Zalesskya* and *Thamnopteris*) "forms may yet be discovered which it would be difficult to assign to one or the other of these families. Indeed, it may be that we already have one such form in *Grammatopteris Rigolloti*".[4] Our knowledge of the type-specimen still remains where it was thirty-seven years ago, but my reinvestigation of an allied species, *G. Baldaufi*,[5] discovered in the Lower Permian of Chemnitz (Saxony), has shown that *Grammatopteris* is indeed a synthetic type of great interest, simpler in structure as well as geologically older than both *Thamnopteris* and *Zalesskya*. While a full description of *G. Baldaufi* will shortly appear elsewhere,[6] a few of the main features of theoretical interest may be summarised here. The type-specimen was originally described by Beck under a new generic name, *Protothamnopteris* in ignorance of Renault's work. The habit was that of a small tree-fern with the base of the stem clothed in a felt of adventitious roots. The petioles were cylindrical, as in the Zygopterideæ; they were devoid of the stipular expansions so constantly found in the Osmundaceæ, both recent and fossil. The stem had a solid protostele, consisting only of tracheids, but faintly differentiated into a stellate central xylem, composed of mixed ordinary and parenchymatous tracheids, and a relatively thin outer xylem. The periphery of the outer xylem was more or less deeply invaginated by narrow vertical slits which no doubt represent rudimentary leaf gaps homologous with those of the Osmundaceæ. The protoxylem cannot be located with certainty but was probably represented by scattered groups of narrow tracheids in the central xylem. The leaf traces arose in spiral sequence, the phyllotaxis varying from about 5/13 near the base to a more crowded arrangement, like that of *Thamnopteris* and other Osmundaceæ, higher up. The foliar trace was at first elliptic in cross-section, but finally assumed the form of a straight tangential band with the two marginal protoxylems characteristic of the genus. It is probably a fact of some phylogenetic significance that this simple type of foliar bundle fits in readily with the zygopterid ground-plan. Diarch roots arose from the abaxial sides of the leaf-traces in the region of the cortex.

Thus, while in its foliar characters *Grammatopteris* clearly approaches the Zygopterideæ, its stem structure is paralleled by members of both the Osmundaceæ and the Zygopterideæ. On the whole there seems to me to be a somewhat stronger case for regarding the genus as azygopterid than for referring it to the Osmundaceæ. Professor A. C. Seward, F.R.S., to whom I am deeply indebted for opportunities of discussion, is inclined to think that the affinities are rather more on the side of the Osmundaceæ. I am prepared to confess that the balance is very nearly even and that my choice may have been largely influenced by the personal factor. But the main point is that we cannot with full confidence assign the genus to either of these families, and this is perhaps the strongest proof of their affinity and their common ancestry.

B. SAHNI.

University of Lucknow,
*September* 25, 1932.

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1 *The Fossil Osmundaceæ*. Pts. I-V. Trans. Roy. Soc. Edinb., Vols. XLV–XLVII, L. Pt. 3, pp. 663–664; Pt. 4, pp. 466–473 (1907–1914).

2 *Bassin houiller et permien d'Autun et d'Epinac*, II (1896).

3 *loc. cit.*, Pt. 1, p. 778.

4 *Ann. of Bot.*, **32**, 374, 1918.

5 Beck, R., "Ueber *Protothamnopteris*", *Abh. Sächs. Akad. Wiss.*, **36**, V, 1920.

6 *Ann. of Bot.* (Current volume).

### Hyperfine Structure of Mercury Lines.

THE hyperfine structure of mercury lines has been studied by various observers but the results do not uniformly agree. Starting from the structure of $\lambda$ 4916 ($6^1P_1 - 8^1S_0$) given by Venkatesachar and Sibaiya,[1] the author and T. G. Srinivasa Iyengar[2] set up a term scheme to explain the structure of

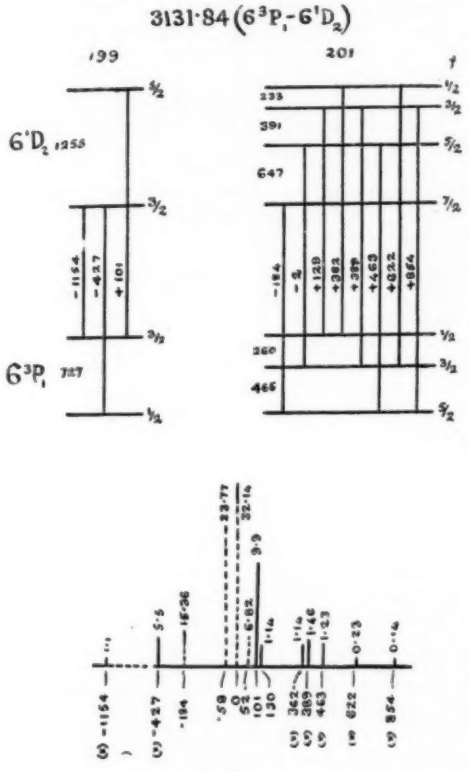


Fig. 1.

4916, 5791 ($6^1P_1 - 6^1D_2$) and 5770 ($6^1P_1 - 6^3D_2$). The structure of 3654 ($6^3P_2 - 6^3D_2$) and 3125 ($6^3P_1 - 6^3D_2$) was thence deduced and found to be in agreement with that recorded by Nagaoka.[3] Schüler and Jones[4] and Murakawa[5] have given another term scheme for these lines, based upon the structure of 4916 found by Schüler and Keyston[6] and Murakawa[7] respectively. The measurements of Nagaoka are in better accord with the scheme given in the paper above referred to.[2] Schüler and Jones[8] have recently found it necessary to alter the level scheme of 5791 in order to bring it into accord with the structure given by Görlich and Lau,[9] which, however, still contains some compo-

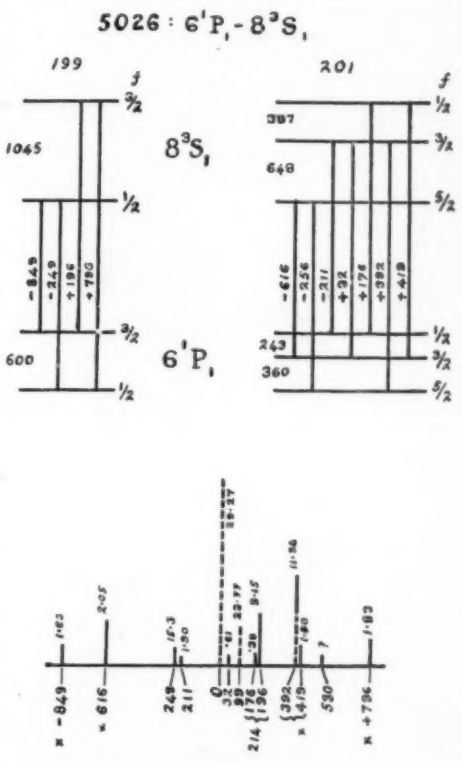


Fig. 2.

nents not coming under Schüler's scheme. The scheme set up by Murakawa is substantially the same as that of Schüler and Jones[4] except that the level-separations are slightly different corresponding to differences in the wave-number separations of the satellites. Now this scheme gives for 3131.84 ($6^3P_1$ - $6^1D_2$) a structure very different from that of Nagaoka, which can, however, be explained

[1] *Journ. Mys. Uni.*, **4**, 148, 1930.
[2] *Proc. Roy. Soc*, **A. 137**, 216, 1932.
[3] Quoted by Ruark, *Phil. Mag.*, **1**, 977, 1926.
[4] *Zs. f. Phys.*, **74**, 63, 1932.
[5] *Sci. Papers Inst. Phys. Chem. Res., Tokyo*, **18**, 177, 1932.
[6] *Zs. f. Phys.*, **72**, 423, 1931.
[7] *Zs. f. Phys.*, **73**, 366, 1931.
[8] *Zs. f. Phys.*, **77**, 801, 1932.
[9] *Zs. f. Phys.*, **77**, 746, 1932.

as shown in Fig. 1 on the basis of the scheme proposed by the author and T. G. Srinivasa Iyengar. This scheme is also able to account for the structure of 5026 ($6^1P_1 - 8^3S_1$) given by Venkatesachar and Sibaiya[10] as shown in Fig. 2. The scheme of Schüler and Jones cannot be reconciled with this structure. Fig. 3 shows the structure of

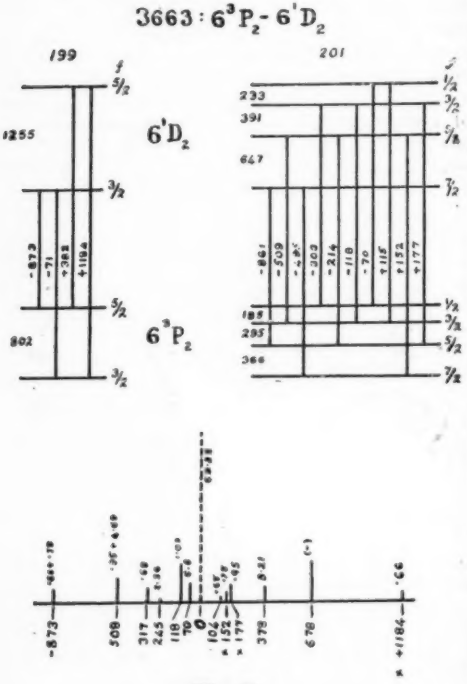


**Fig. 3.**

3663 ($6^3P_2 - 6^1D_2$) deduced from that of the $6^1D_2$ level given in the previous paper.[2] Unfortunately the diagram given in that paper for 3663 shows the levels upside down owing to inadvertence in copying from the rough manuscript. The positions of the satellites now given agree with the measurements of Nagaoka although the intensities are not so well explained. The structure deduced by Schüler and Jones is markedly different from that given by Nagaoka.

It is remarkable that the structures of some lines in regard to which earlier observers were in substantial agreement differ materially from the results of later investigators. The situation is equally puzzling in the case of lead. Thus Wali Mohammad and Sharma[11] obtain results exactly coinciding with those of previous observers like Janicki while in many cases the results of Kopfermann[12] and the similar ones of Rose and Granath[13] differ markedly from these. It is not easy to make self-reversal and absorption alone responsible for such contrary results. Unless the causes of this discrepancy between the results of equally reliable observers are found out and allowed for, the problem of hyperfine structure will remain without a unique solution.

T. S. SUBBARAYA.

Department of Physics,
Central College, Bangalore.

[10] *Naturwiss*, **19**, 1041, 1931.

## Size of the Liquid Drops on the Same Liquid Surface.

IN the previous papers the author has studied the general accounts of the liquid drops on the same liquid surface,[14] the effect of the surrounding medium on the life of liquid drops[15] and water as a suitable liquid for the formation of such drops.[16] Now the author has studied the factors which increase their size and has arrived at the following conclusions :—

1. That the size of the floating drops depends upon two factors, *viz.*, (*a*) the diameter of the burette and (*b*) the surface tension of the mother liquid.
2. That the size of the floating drops is independent of (*a*) the viscosity and (*b*) the density of the mother liquid.
3. That the surface tension of the mother liquid affects the size of the primary as well as the secondary drops formed by any method.
4. That the diameter of the jet affects the size of only the primary drops formed by burette method. It neither affects the primary drops formed by any other method nor the secondary drops formed by any method.

L. D. MAHAJAN.

*Camp*—Sundarnagar,
Suket State, India,
*September* 12, 1932.

[11] *Phil. Mag.*, **12**, 1106, 1931.
[12] *Zs. f. Phys.*, **75**, 363, 1932.
[13] *Phys. Rev.*, **39**, 1017, 1932.
[14] J. B. Seth, C. Ananda and L. D. Mahajan, "Liquid Drops on the Same Liquid Surface," *Phil. Mag.*, **7**, pp. 247-253.
[15] L. D. Mahajan, "The effect of the surrounding medium on the life of liquid drops," *Phil Mag.*, **10**, pp. 383-386.
[16] L. D. Mahajan, "Liquid Drops on the Same Liquid Surface," *Nature*, **126**, p. 761; **127**, p. 70.

## Chromosome Number in Pyrgomorphinæ (Acrididæ).

WITH reference to a preliminary note on the "Chromosome Number in Pyrgomorphinæ", by Mr. Ramachandra Rao in these columns,[1] I wish to state that observations on chromosome number, sexchromosome, etc., in the male germ-cells of *Poeciloceera*, *Pyrgomorpha*, *Colemania* and *Chrotogonus* have been published by me in the form of short notes.[2] I have also observed the remarkable deviations noted by him in the chromosomal complex of Pyrgomorphinæ in the genera mentioned above.

With regard to the chromosomes of *Colemania* and *Chrotogonus*, it is gratifying to note that Mr. Ramachandra Rao in his preliminary communication to this journal confirms what has been observed by me elsewhere.

A paper embodying the observations on the chromosomes of these forms will be published soon.

J. J. ASANA.

Ismail College,
Jogeshwari (Bombay),
*September* 22, 1932.

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## Further Notes on the Chromosomes of Pyrgomorphinæ.

IN the note on the chromosome number in Pyrgomorphinæ, published by me in *Current Science* (August 1932) I recorded preliminary observations on *Colemania*, *Chrotogonus* and *Aularches* and omitted to mention the previous work of Prof. Asana on the same subject which he has communicated to the Indian Science Congress in 1928 and 1930. The reason for this omission is not to rob the Professor of the merit for priority which would be handsomely acknowledged in my fuller paper which is in the course of preparation and moreover my published account will be found to differ from his observations in certain material respects. Further, my work on *Colemania* has been undertaken mainly with a view to determine the possible relation of the changes in the germ cycle of the male forms with the periodicity of their occurrence and I extended my studies to the allied forms for securing collateral evidence in support of the views I am led to form from an examination of my material. There are only two forms *Colemania* and *Chrotogonus* which form the common subject of investigation by Prof. Asana and myself, and in the case of the latter I differ from him in certain regards.

The present communication refers to the extension of my studies of the chromosome behaviour in *Orthacris*, another Pyrgomorphine, fairly common in Mysore, feeding largely on mulberry. This genus shares the general chromosome characteristics of the sub-family in possessing the reduced number of chromosomes. The diploid number in the male is 19. There are the usual ring, rod, and V-shaped tetrads (Fig. 1). A very

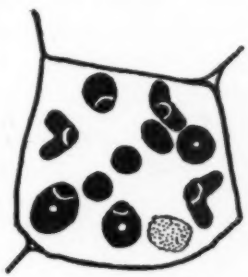

**Fig. 1.**

**Fig. 2.**

interesting feature is the occurrence in the first spermatocyte metaphases of one of the individuals studied, a J-shaped tetrad (Fig. 2). This is due to the presence of a pair of heteromorphic homologous chromosomes, resulting from the fact that in one of the homologues the spindle fibre attachment has shifted from the usual terminal position and assumed an atelomitic condition. Fig. 2 *a* shows the tetrad placed on the spindle axis and Fig. 2 *b* an early anaphase where the dissimilar homologues are separating. More specimens are being examined for finding out whether such forms occur more often and efforts are also being made to discover why exactly the shifting of the fibre attachment has taken place. A detailed paper on the spermatogenesis of *Orthacris* will be communicated to the next Science Congress at Patna.

T. RAMACHANDRA RAO.

Department of Zoology,
Central College,
Bangalore.

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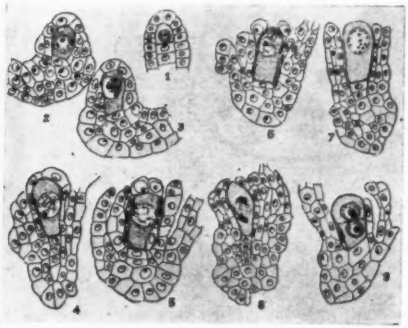
[1] *Cur. Sc.*, Vol. I, No. 2, p. 41.

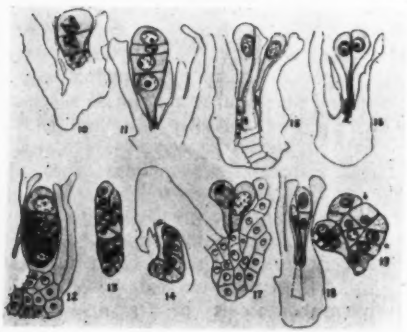
[2] *Proc. Ind. Science Congress*, 1928, 1930, 1931.

### Development of the Female Gametophyte and Embryo in *Spiranthes australis* (Lindley).

IN the course of the researches on the Orchid embryo-sac and embryos, the following interesting observations have been made in *Spiranthes australis* (Lindley).

The Megaspore-mother cell (Fig. 1) undergoes the various stages of Hetero- and homotypic divisions (Figs. 2 to 10) and forms the "linear tetrad" (Fig. 11). All the four cells of the tetrad function to form an embryo directly by further divisions (Figs. 12, 13, 14) instead of going through the different usual stages, namely, the degeneration of the three megaspores, formation of an embryo-sac, fertilization, and the development of an embryo by the fertilized egg. This manner of embryo formation has not been reported before in Angiosprems. The number of chromosomes in this plant will be reported shortly.





Another feature of interest is that some of the wall cells which are nucellar in nature, and which usually degenerate in the other Orchids, develop, actively divide, and give rise to additional embryos (Figs. 15 to 19). Figure 15 illustrates the degenerating central megaspore-mother cell and the two developing wall cells. Figure 19 shows a group of three embryos, one developed from the megaspore-mother cell (*a*) and the other two (*b* & *c*) from the wall cells. Attempts are being made to germinate these seeds and grow them to the adult size.

*Spiranthes* is a marsh orchid. How far this course of development which is peculiar to it is due to the ecological conditions is being studied at present.

K. N. SESHAGIRIAH.

Department of Botany,
Central College,
Bangalore,
*September* 26, 1932.

### Albino and White-Striped Characters in Rice.

SELF-POLLINATED seeds of apparently pure green types produce a number of seedlings deficient in chlorophyll. Most of them are entirely chlorotic which soon die in the seed bed, while a few are partially so giving a variegated appearance to the plants with white-striped leaves. The latter survive although in a weak condition and produce normal grains. These chlorophyll abnormalities in individual types are on the whole very few in comparison to the green population therein and especially the white-striped plants which are very rare. Both kinds of chlorophyll abnormalities have been studied by a number of American workers in maize and sorghum, and by Kondo[1] in rice. The albino character has been studied by Ramiah[2] in rice. Kondo observed the albino and variegated characters of the non-Mendelian maternal inheritance while Ramiah noted the albino and pale-yellow seedlings to be Mendelian recessive in character segregating in 3 : 1 and 15 : 1 ratios. In our work the albino seedlings were found to appear in a large number of types ranging from .26% to 20% without showing any definite ratio, the crosses showing an increased percentage than the ordinary pure types as pointed out by Ramiah.

In 1926 three white-striped plants appeared in an apparently pure type in the observation plot at the Government Rice Experiment Station at Titabar (Assam). Both the leaf and grain showed the white-stripes distinctly. Germination tests of seeds obtained from them produced 100% green seedlings in

[1] *Ber. Ohara. Inst. Landw. Forsch.*, **3**, 3.
[2] *Mem. Dept. Agric., India*, Vol. 8., No. 7.

some, whereas 69% green, 23% white-striped and 8% albino seedlings were produced in others. In one case the ratio of white-striped to albino was 3 : 1 showing a fairly good fit. As recessive lethal characters tend to eliminate in time in competition with the normal allelomorphs, we have obtained a pure white-striped type later in two successive generations.

In both natural and artificial crosses the white-striped character segregated in $F_2$ in 3 : 1 ratio with a good fit and that one pair of factors were involved in them. The $F_3$ results in both confirmed the same. A heterozygous green plant back-crossed with a recessive white-striped plant gave 17 green: 14 white-striped plants with a deviation of $1.5 \pm 1.87$ from the expected number of 15.5 in each case. In fact, the white-striped character has been found to segregate as a simple Mendelian recessive to green in natural, artificial and back-crosses.

S. K. MITRA.

Jorhat (Assam).

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## Peculiar Bisexual Cones of *Pinus longifolia*.

IN my previous paper[1], I described the hermaphrodite cones of *Pinus longifolia* and *Picea morinda*. The features recorded about *Picea morinda* are very rare in occurrence,

**Fig. 1.**

the only other instance being that of *Abies excelsa*[2] and those about *Pinus longifolia* have not previousjy been recorded. My recent collections contain some peculiar cones of *Pinus longifolia*, a brief description of which is given below. The terminal portions of the cones are occupied as in the normal female cones by a compact group of megasporophylls. Below this zone, on the same axis of few cones, there is a circlet of male cones varying in number from 1 to 10 much smaller than the normal male cones (Fig. 1). However, in some others the male cones are intermixed with female cones ranging in number from 1 to 5 (Fig. 2). These axillary female cones are much smaller than the axillary male cones and the terminal female cone. Below this zone, the axis is covered over by the usual scales

**Fig. 2.**

and still lower down, bundles of needles appear at the axil of the scales. The development of these cones seems to be quite normal, no physical deformity or disturbance being noticed. Further details of the structure and significance of these cones will soon appear elsewhere.

L. N. RAO.

Department of Botany,
Central College, Bangalore,
*August*, 1932.

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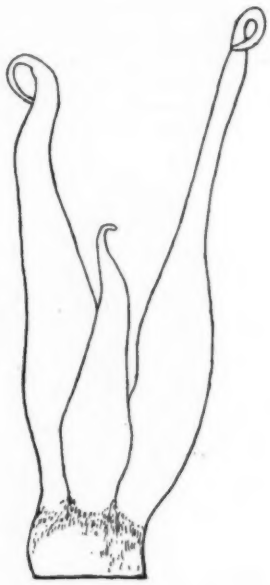
[1] L. N. Rao, "Bisporangiate Cones of Pinus longifolia and Picea morinda," *Jour. Ind. Bot. Soc.*, **10**, No. 3, 1931.

[2] Dickson, A., "Observations on some Bisexual Cones occurring in Abies excelsa," *Trans. Edinbg. Bot. Soc.*, **6**, 1860.

### Multicarpellary Apocarpous Pistils in *Poinciana regia* Boj.

IN this short note the abnormal occurrence of multicarpellary apocarpous gynaecia is recorded in *Poinciana regia* Boj, collected locally by the writer in the first week of August. Several flowers were collected in which the pistil was composed of more than one carpel. One such, from a not very immature flower-bud, is sketched in the accompanying figure, after the removal of



*Poinciana regia.*
An abnormal pistil showing three carpels.

the sepals, petals and stamens. In the material examined flowers were seen having 2-4 carpels. All the carpels were never of the same size. In many cases, one could make out from the outside a central growing point-like structure and it appears that this goes on forming new carpels laterally in acropetal succession. A detailed histological investigation is on hand and results will be published in due course.

A. C. JOSHI.

Botany Department,
Benares Hindu University.
Benares,
*August* 18, 1932.

### On the Wave-Statistical Theory of Unimolecular Reactions.

IN a previous paper, a relation between the disintegration constant and velocity of α-particles in radioactive disintegration was established by Kar and the author introducing a damping factor in the wave equation. In this paper it is suggested that the reacting molecules first of all absorb energy A—Q where A is the 'activation energy' and Q the heat of reaction such that the decomposed products and undecomposed molecules should be at the same energy level, before spontaneous damping or in the language of wave mechanics, 'austausch' takes place. This is analogous to the familiar activation hypothesis. Considering two regions, $x < r_0$, where damping takes place, and within which the molecules are present as complete entity and a region $x > r_0$, at the boundary of which there is a potential barrier which the resultant products must overcome, the following expressions for the velocity co-efficient are deduced:—

$$k_1 \sim \frac{0{\cdot}91}{h}\sqrt{(\mathrm{A}-\mathrm{Q})\,\mathrm{A}}\; e^{-\frac{\mathrm{A}}{kT}} \quad .. \qquad .. \quad (1)$$

(First approx.)

or if $\mathrm{Q} \sim 0$, $k_1 \sim 0{\cdot}91\,\nu\, e^{-\frac{h\nu}{kT}}$ .. (1*a*)

where $\mathrm{A} = h\nu$

and $\mathrm{A} = exp.\frac{\beta\,(\mathrm{Q}-\mathrm{A})}{\sqrt{\mathrm{A}}}\; e^{-\frac{\mathrm{A}}{kT}}$ .. (2)

where $\beta$ is constant and the damping co-efficient is large. Another alternative expression is obtained for the case when the damping is small in the following form:

$$k_1 \sim .e^{\beta'\sqrt{\nu+\mathrm{Q}-2\mathrm{A}}}\,.\,e^{-\frac{\mathrm{A}}{kT}} \quad .. \qquad .. \quad (3)$$

It is to be noted that equation (1*a*) is similar to the expressions of Dushman, Polanyi and Wigner and the author, while (2) is similar to that obtained by Roginsky and Rosenkewitch.[1] The last two expressions involve the distance $r_0$ indicating that although ordinarily the reaction velocity co-efficient is independent of concentration, modification may take place at very low pressure either by the change of $r_0$ or diminution of the damping co-efficient on account of the abnormal decrease of density.

A. GANGULI.

Chandernagore,
*September* 1932.

[1] *Z. Phy. Chem.*, **10B**, 47, 1930.

## Research Notes.

### Experiments on the Development of the Chick and Duck Embryos cultivated *in Vitro*.

THE latest contribution to our knowledge of the potentialities of an organizer-region of the blastoderm of chick is a paper by C. H. Waddington[1] who during the course of his studies has reached most interesting conclusions as regards the rôle played by the primitive gut, primitive streak and the influence on each other of the germinal layers. The previous workers who adopted the method of isolation, were mainly concerned with the study of self-differentiation of tissues of Fowl embryo which they transplanted to the chorio-allantoic membrane and also by cultivating them *in vitro*. Waddington used the latter method in his study of the developmental mechanics of the early chick and duck blastoderm, especially during the stages between the laying of the egg and the appearance of the head process. The first set of experiments deals with the normal *in vitro* development of the chick and duck and the determination of the location of the organ-forming materials in the early stages of the blastoderm. The explanted embryo of the chick which remains alive *in vitro* for 2 or 3 days, reaches the critical period when the circulatory-organs appear and possibly due to a maladjustment of the beating of the heart and the blood formation in the area vasculosa, the embryo dies. The rates of growth and of differentiation are always slower *in vitro* than *in vivo* and the difference, according to Waddington, is nearly represented by the ratio 1 : 1.5. In his studies on the differentiation of portions of blastoderm, he shows that if a cut is made through the primitive pit or just in front of it, before the appearance of the head process, no embryonic organs are developed in the anterior regions, except a small quantity of neural tissue; if, however, the cut is made just behind the primitive pit, a head and also a thin tail are formed, the latter bearing a medullary plate, somites and a notochord. In the first experiment, chiefly where the blastoderm is cut through the primitive pit, the half behind the cut develops all the axial structures except part of the head. If the embryo is cut a little behind, and well behind as far back as the middle of the primitive streak, it is noticed from Waddington's data, that while in the former case, at least medullary folds arise, in the latter there is no trace of embryonic organs. These experiments of Waddington do not confirm the results of authors like T. E. Hunt, B. H. Willier and M. E. Rawles who in employing the chorio-allantoic technique, found that the hinder region of the primitive streak is not capable of self-differentiation in the absence of Hensen's node. In the second set of experiments designed to test the organizing influence of endoderm in the development of the embryo there were two distinct lines of investigations. Isolated endoderm and epiblast were cultivated for purpose of determining the rôle they played in organ formation. If the endoderm is removed in middle or late primitive streak stages of blastoderms the explanted epiblast is found to possess the power of differentiating a neural plate, somites and notochord though somewhat disturbed from their normal relations. The formation of the notochord, which is usually referred to as endodermal in origin, is to be accounted for by the results of recent work in Vertebrate Embryology according to which, the notochord material originally resides in the epiblast and later becomes invaginated at the primitive pit. The explanted endoderm has not given any definite results, though it was noticed that the yolk endoderm cells from the margin of the disc grew centripetally so as to cover the entire area below the area pellucida. Experimentally, on account of great distortions taking place in the explants and the formation of blisters, it is not possible to ascertain the precise age at which the germinal layers acquire the power of self-differentiation and directional influence. Again for the purpose of determining the nature and extent of mutual influence of epiblast and endoderm, Waddington separated them and readjusted them so that the longitudinal axis of the former was at right angles to that of the latter. The results of the experiment naturally will depend on the amount of healing of the tissues and on the extent of the organic contact between them. In successful preparations, positive results have been obtained. It is found that if the operation is performed on a blastoderm in which the primitive streak is not yet fully grown, the direction of its growth is influenced by

[1] *Phil. Trans. Roy. Soc.*, Series B, **221**, 1932.

the position of the endoderm, *i.e.*, anterior part of the primitive streak, and of the resulting neural folds is bent towards the anterior end of the endoderm while the posterior end of the primitive streak is deflected away from this pole. Waddington points out that the definite deflection of the primitive streak and the neural folds may not be a secondary phenomenon due to the mechanical properties of the tissues, but should be explained on the hypothesis that as in the formative stages of the primitive streak, its axis is determined by the growing endoderm below, this influence of the anterior end of the endoderm is continued to be exerted even under experimental conditions. The endoderm, chiefly at the growing points, has therefore a direct influence on the axial relations of the primitive streak and also those of the neural folds. The continuity of the neural plate without interruption or lesion points to the fact that the neural material is derived only from presumptive medullary material and not from other sources.

The next series of experiments deal with the determination of the nature and scope of the organizing influence of the primitive streak, firstly by testing the inductive capacity of the entire structure and then that of isolated pieces. When two specimens of blastoderm, the underlying endodermal layer having been removed, are opposed so that their ventral faces are in contact and the primitive streaks do not touch their whole length, definite evidence is obtained that the growing primitive streak can induce the formation of a medullary plate in an epiblast with which it is in contact. Waddington further evidences in support of the view that the induced medullary plate is not formed from presumptive neural material which has been prevented from moving to its normal place, by the removal of the endoderm, but the induction is due both to the form building movements and the qualitative differentiation of the cells. To the interesting inquiry whether a medullary plate in these experiments can be induced at any angle to the normal neural plate of the same epiblast, the answer is furnished that they can be induced in any orientation making an angle of 150 degrees. The grafting experiments devised for the purpose of testing the inducing capacity of the primitive streak, either whole or in fragments taken from definite regions, shows that practically all the grafts give rise to a certain amount of mesoderm and as regards the neural tissue, the anterior portions of the primitive streak frequently and the posterior rarely, and the middle pieces sometimes do form. In these experiments, fragments of primitive streak were introduced between the endoderm and epiblast of a blastoderm chiefly through a hole made in the endoderm. If pieces of the primitive streak were cultivated separately they are observed to differentiate to neural tissue, somatic mesoderm, and the injured part of the primitive streak regenerates. If in the process of regeneration the epiblast were considered as a whole, these two organ forming movements, the superficial centripetal and the deeper centrifugal, leading to the adjustment of the tissues, and the capacity for the induction of tissues is possessed by the primitive streak and the labile determination of the presumptive tissues is dependent on the tissue forming movements.

In summarising this piece of extraordinarily interesting work, it was found necessary to follow clearly the different types of experiment in the order in which they have been described and also the language of the author as far as possible in order to sustain the interest of scientific readers.

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### The Innervation of the Heart of the Crustacea.

[J. S. Alexandrewicz, *Quarl. Journ. Micros. Sci.*, **75**, No. 298, June 1932.]

IN the heart of the Decaped Crustacea three systems of nervous elements can be distinguished: (*a*) a local system of neurons distributed in the heart itself supplying impulses necessary for the regular contractions of the muscles of the heart; (*b*) a system of fibres running from the Central nervous system to the heart, inhibitory and acceleratory in function; (*c*) a system of nerves supplying the valves of the heart holding their muscle fibres in contraction during the diastolic period of the heart. There are also nerves supplying the muscles of the pericardium which are evidently sensory in function.

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### The Origin and Migration of the Primordial Germ-cells of Sphenodon Punctatus.

[Margaret Tribe & F. W R. Brambell. *Quart Journ. Micros. Sci.*, **75**, No. 298, June 1932.]

THE primordial germ-cells of Sphenodon originate in the yolk-sac endoderm and are

differentiated very early. They are very large in size and are filled with yolk-granules. They migrate through the yolk-sac endoderm and mesoderm by their own amœbeid movements entering the embryo by way of the venous blood stream or by migration through the extra-embryonal endoderm and splanchnic mesoderm. They thus reach the germinal ridges, lose their yolk content and enter the prophase of the heterotypic division.

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### Sex Reversal and Experimental Production of Neutral Tassels in Zea mays.

[John H. Schaffner, *Bot. Gaz.*, **90**, 3, 1930.]

THE fact of sex reversal has been established for many species of plants, the reversal being brought about commonly in one direction as readily as in the other, *i.e.*, from male to female and from female to male. In the transition from one sex to the other, a physiological state of zero or neutral point must be passed through. This transition neutral condition is interesting on account of the characters developed in the tissue. For example, monœcious or diœcious species frequently develop bisporangiate flowers on the neutral zone, others develop sex mosaics, rudimentary flowers or peculiar vegetative structures. The author concludes that by simple control of environmental conditions vestigial tassels can be produced in Zea mays at will, the natural photoperiodic gradient extending from August to November, producing sometimes 40% or more of neutral tassels in a lot. The following general types of tassels can be developed by proper photoperiodicity, staminate, carpellate and neuters and four sex mosaics—staminate neuters, carpellate neuters, staminate-carpellate and staminate-carpellate-neuters. With the decreasing photoperiodicity, femaleness is only expressed at the base of the tassel, the top being neuter and the middle region staminate. With the increasing photoperiodicity, femaleness may also be expressed at the top of the tassel and its branches, or sometimes forming sex mosaics. Even pure lines react to photoperiodicity in the same way as commercial heterozygous varieties giving rise to complete sex reversals and all possible types of sex mosaics. Male expression can be suppressed completely in the monœcious Zea mays when it is grown in a decreasing photoperiodic environment of suitable length. The specific sex condition developed is independent of any balance of sex determining or sex producing genes. It is obvious that genetic experiments involving sex conditions are of no value unless the reactions obtained are interpreted in the light of ecological conditions present.

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### Nature and Development of the Tracheids of the Ophioglossaceæ.

[Gasper A. Luhardge, *Bot. Gaz.*, **98**, 2, 1932.]

THE object of the study has been the tracing of the development of the tracheids of the Ophioglossaceæ, since tracheids are unusual for ferns, in that they bear on their walls distinct bordered pits resembling those characteristic of many of the higher plants, instead of scalariform markings characteristic of Filicales. All the three genera of Ophioglossaceæ are considered. Fresh material was fixed in Jeffrey's corrosive sublimate and picric acid, alcohol-formalin, and alcohol-formalin-acetic acid. All material was treated with 10% Hydrofluoric acid for a week to remove traces of silica. Erythrosin and crystal violet, safranin with crystal violet and hæmatoxylin (Ehrlich's and Heidenhain's) were used. Combination of foast-green and safranin gave excellent differentiation of the three regions of the wall. The terminal buds in most species of Ophioglossaceæ consist of a series of three to five leaves, one of which reaches maturity each year. The rate of differentiation and maturation of tracheids is rapid and takes place just behind the apical region of the stem, the transition region being very short. The differentiation and maturation of the leaf-trace is very slow, this being attributed to the rapid growth of the leaf and the consequent extension of the region over which differentiation takes place, whereas the stem, being less conservative, crowds the transition region to a short space. Lignification and maturation of tracheids begin in the leaf as early as four years before the leaf reaches maturity. The secondary thickening differs from that of the Spermatophytes in being made up of cellulose and the tertiary thickening of lignin, which covers the secondary thickening and forms bordered pits.

# A Marine Biological Station in Bombay.

By S. B. Setna, M.Sc., Ph.D. (Cantab.),
*Royal Institute of Science, Bombay.*

THIS subject has been so fully discussed in the lay press that some apology may, perhaps, be necessary for the present note. The only excuse is that by repeatedly harping on the subject of "Marine Biology for India," we may at last expect the realization of the wants of Indian Biologists. Apropos of this, it would not be out of place to refer to Professor J. Stanley Gardiner's view, "That the great deficiency of all my Indian research pupils, however brilliant their university careers have been, is their lack of understanding of what life really means and how living matter reacts. They have read well but the proper understanding of Biological questions is bound up with the study of living animals. It is the custom here and in every country of Europe to send their high grade pupils to marine stations for study and of these I recall 15 in Western Europe to which I have at times sent pupils. They keep animals alive and study them, make experiments on them alive by altering the temperature of the water in which they live, the kinds of salts in the same, varying the conditions of light, etc. In America they are even stronger on the necessity for such visits than we are, regarding scientific training incomplete without them. Egypt at the present moment is erecting its marine station at Ghardaga on the Red Sea, regarding it as a necessity for its students. I do hope Bombay will give its students a station too."

From my personal knowledge, I think that there can be hardly a more suitable site for the establishment of a marine biological station than Bombay. The faunistic conditions of the waters near Bombay are fairly good. It is surrounded by the sea on all sides. The most important feature that should commend itself in the choice of a site, is the existence of a university on its littoral. As a railway terminus and junction, Bombay is equidistant from almost all the leading centres of biological investigation in India. Being within easy reach of most university towns in the country, it is not an idle expectation that the distinguished zoologists, who staff these institutions, will visit Bombay for a study of marine problems and that the proposed station will ultimately justify its existence.

We may now turn to discuss briefly the effect of the establishment of such an institution, its necessity for a proper understanding of zoological problems and its utility to commerce. A well-conducted Marine Biological Station will first enable the country to systematize its fisheries which at present are largely conducted on obsolete, unscientific, crude and wasteful methods. In respect of its fisheries India obstinately clings to habits which are now generally discarded. Modern methods and up-to-date scientific appliances which are in universal use in the West have not yet been adequately availed of here. In matters relating to the application of science to industry our country is hopelessly behind the times.

The value of fisheries as source of income to the country's revenue may be gauged from the fact that in Great Britain in one year alone, and that too a long while back when the fishing industry was still in an experimental stage, nearly a million and a quarter tons of fish were landed. Its value at the port of landing was computed to be £15,000,000 as compared with £13,000,000—the value of one and a half million tons of wheat grown in the same year. Since then the yield from the British fisheries has almost trebled in value. Aware of this, almost all countries in Europe situated on the sea board have made vigorous efforts to develop their marine sources of wealth. Turning to India what do we find? A distressing tale due solely to lack of enterprise and tardiness to give encouragement when the initiative has been taken. It is most disheartening to find that in India almost no effort has as yet been made to develop the almost inexhaustible resources that are lying so plentifully at our very door-step.

At present almost all the fishery work in India is haphazard and unscientific. Our fishermen—and even we people with scientific training—know practically next to nothing of the migratory instincts of the fishes they are in quest of, of their haunts and spawning grounds. Similarly, they have next to no knowledge of the movements, direction and rate of the currents, the temperature of the water, the nutrition taken by sea creatures and countless other physical and physiological factors. Both from strictly scientific considerations and in the interests of fishermen, it is of vital importance to collect the maximum data relating to fishes and their conditions of life and this not in the present empirical fashion, but with a scrupulous regard for the verification of every piece of information by scientific observation and experiment.

It is tragic to find that the study of Biology in Indian universities is a travesty of what is implied by that term and is a study of not life, but of death, for most of the specimens which form the subject of laboratory work, are dead. The anomaly does not end here and it is a curious reflection on our methods of organization and study that even in the case of a large number of dead specimens, the majority of them come from Europe. Could anything be more absurd than that this so-called study of Biology should relate to creatures that our students have no opportunity of seeing and of whose real life habits they can know nothing? It is no Biology, but hearsay. It is high time this farce ended and that such unscientific training of our students was revealed in its naked reality.

Of the various institutions, which combine both pleasure and instruction, it is difficult to conceive of anything more attractive than a well-organized marine biological station with its aquarium. The marine biological station, if efficiently maintained, will display a large range of marine fauna. On payment of a small charge the aquarium could be open to the public as a sort of museum. The revenue thus derived could be devoted to the establishment charges. That the income from this head is likely to be large may be gathered

from the case of the Madras aquarium which gets an annual revenue of about Rs. 10,000 on an average. Bombay is far more thickly populated than Madras. More people visit Bombay and as a centre of commerce and trade it has a large floating population, which will add very largely to the revenue; it is therefore to be expected that the annual income from the Bombay station will exceed that of Madras by several thousand rupees. Taking a moderate estimate I should put it down to at least about Rs. 15,000 per annum.

I am of the opinion that a small start should be made at the beginning. The local Government, it is understood, has been moved to grant gratis a site for the location of the station. A miniature laboratory would be enough in the early stages. A library is an expensive but an indispensable requisite, but this may be overlooked as the Royal Institute of Science has a fairly good collection of books bearing on the subject, and its library may be availed of by students working at the station. This will be a great saving as far as a very important feature of the station is concerned.

The income of the station will be derived from:—(1) admission charges to the aquarium, (2) supply of marine specimens to places inland, (3) rental of tables. A unique feature of the European stations is the table system of support. The stations have a number of tables and undertake to provide research privileges for any institution or person who books a table for a whole year. The above three heads do not exhaust all the sources of revenue. Other likely heads of income are grants from the Government, universities in India, the local Ministry of Agriculture, the Bombay Natural History Society and, last but not the least, donations from public-spirited and generous citizens. But all these sources of revenue will only go to the maintenance and upkeep charges. The main problem is the initial expenditure for founding the station. For this a sum of at least Rs. 1,00,000 is needed, the whole amount being absorbed in meeting the expenses of the erection of the building and the provisions of just the ordinary equipment and essential apparatus for investigation.

What is now urgently needed is the energetic and wholehearted co-operation of all the universities in India to make this suggestion a reality, for it is the universities and their countless throng of students who will ultimately derive the maximum profit from the station. The absence of such a station is a lacuna in our scientific organization, the existence of which we should not allow to continue a moment longer.

We earnestly hope that the cause for reproach on this score will be wiped out in the immediate future.

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## The Late Colonel Sir Ronald Ross, K.C.B., K.C.M.G., F.R.S., LL.D. (1857-1932).

THE great pioneers of tropical medicine are rapidly leaving us; Manson has gone, Laveran has gone and now Sir Ronald Ross has been taken from us.

The strides which have been made in the investigation of tropical diseases, since Laveran discovered the malaria parasite in 1880, have probably been greater than in any other branch of medicine. The majority of this development has taken place since the epoch-making discovery by Ross in 1897 that malaria was carried by the mosquito.

One will always associate the science of malariology with the name of Ross. If one considers the statement of that great physician, Osler, that "if a census were taken among the world's workers on disease, the judgment to be based upon the damage to health and direct mortality, the votes would be given to malaria as the greatest single destroyer of the human race", it is not then too much to say that Ross' discovery was one of the greatest, probably the greatest, made in medicine in the last half century. It has saved innumerable lives and has made practicable the development of large areas of the tropics which were previously uninhabitable.

Every worker in tropics, be he trader or missionary, soldier or sailor, engineer or doctor, miner or agriculturist, owes a debt of gratitude to this great scientist. India with her estimated death rate of one million per annum from this disease, is especially indebted to Sir Ronald Ross, whom she can proudly claim as especially her own, for he was born at Almora in the Kumaon Hills on 13th May, 1857, of a family with many associations with this country. He spent 18 years as an officer of the Indian Medical Service and it was in India that he made his great discovery.

Sir Ronald Ross received his medical education at St. Bartholomew's Hospital and entered the Indian Medical Service in 1881. His early inclinations were towards literature and mathematics, but he did not neglect his profession, for he was one of the first medical men to take the diploma in Public Health.

His interest in malaria commenced early in his Service and he was awarded the Parke's Memorial Prize in 1895 for an essay on malaria. In this he put forward evidence against the generally accepted theory that the disease was caused by miasma arising from swampy areas. It was at this period that he came in contact with Sir Patrick Manson and, as a result, returned to India full of enthusiasm about research work on malaria. His chief object was the investigation of the theory that mosquitoes were responsible, in some manner, for the spread of malaria, a hypothesis which had been suggested in 1883–84 by King, Laveran and Koch and of which Manson was a strong supporter.

When Ross commenced his work, medical protozoology and medical entomology were in their infancy. No one had even dreamt of the amazing cycles of development which protozoa may undergo in insect hosts, and, except for the discovery made by Smith and Kilborne in 1893 that bovine piroplasmosis was transmitted by the tick, the transmission of protozoal diseases by arthropods was unthought of.

It was on such an uncharted sea that Ross embarked on his return to India in 1895. Through 2½ years of unceasing toil, hampered by heart-rending disappointments and technical difficulties, with indomitable perseverance he struggled on, sustained by the counsel and sympathy of Sir Patrick Manson. About noon on 20th August 1897, in the heat of an Indian summer he saw for the first time the oocyst stage of development of the human malaria parasite in the Anopheline mosquito, and thus opened up a new era in the history of disease transmission.

At this time military duties interrupted his work and not until the following year, when he was placed on special duty at Calcutta, had he an opportunity of completing his research. In July 1898, he was able to telegraph to his friend, supporter and confident, Sir Patrick Manson, that he had proved the mosquito cycle of the malaria parasite by his experimentation with bird malaria and *Culex*. The details of the developmental cycle which he described stands to-day practically unchanged. A Gate of Commemoration was erected at the General Hospital, Calcutta, in 1927, in memory of the discovery and within a few yards of it stands the small laboratory in which the final results were obtained.

Although Ross sometimes spoke of the luck which attended his great discovery, one cannot but think that a lesser man not possessing his grit, energy, determination, and ability, would have given up in despair before the enormous difficulties which beset his path.

Sir Ronald Ross left India in 1899 and was quicky appointed to a teaching post at the newly-formed School of Tropical Medicine in Liverpool. While in this post he took part in many expeditions to the tropics in connection with malarial investigation and prevention. The chief of these were to the west coast of Africa, to Ismailia, to Greece and to Mauritius.

There was no branch of malariology which has not felt his influence. During the 13 years in which he was at Liverpool he taught and inspired many workers, not only in connection with malaria but in relation to many other tropical diseases.

At the outbreak of the Great War he acted as Consultant in Tropical Diseases to the Army with the rank of Colonel. He visited Egypt and Salonika in this capacity and was on a ship which was torpedoed. After the War he was appointed Honorary Consultant in Tropical Diseases to the Ministry of Pensions.

Some years later a public subscription was started which resulted in the foundation of the Ross Institute for Tropical Diseases at Putney Heath. This was inaugurated by H. R. H. The Prince of Wales on 15th July, 1926, with Sir Ronald Ross as Director-in-Chief.

Unfortunately he had a paralytic seizure in 1927, but even this did not stop his unbounded energy and he continued at work, more especially in his mathematical studies, until a few months before his death.

Although he will always be remembered for his medical researches, yet his work on pure mathematics and pathometry, more especially in relation to malaria, was of a high order. His scientific achievements have won for him world-wide fame and have overshadowed his work in the field of art. He was not only a musician but a novelist and a poet. Indeed at one time he seriously contemplated abandoning medicine for literature. Of his poetry Mr. John Masefield, the Poet Laureate, has spoken in most eulogistic terms.

Sir Ronald was always a staunch friend and an enthusiastic helper to research workers who consulted him. The campaign for improving the emoluments and for the

state endowment of research workers received his strong support.

Sir Ronald Ross was made F.R.S. and F.R.C.S. in 1901. He was decorated C.B. in 1902, K.C.B. in 1911 and K.C.M.G. in 1918. His great discovery gained him the Nobel Prize for Medicine in 1902 and very many Governments and Universities have awarded him honours and degrees in recognition of the great benefits which his discovery has conferred upon humanity.

J. A. SINTON, LT.-COL.

## The Industrial Outlook.

### Crisis in the Lac Industry.

By M. Sreenivasaya.

THE Indian lac industry is at the moment passing through a crisis which may be regarded as a logical consequence of the shortsighted policy pursued in the past. The prevailing general trade depression, common to all countries and industries, does not fully account for the increasing decline in prices for lac, and therefore, in this instance, there is not the same hope of a satisfactory recovery when trade conditions improve. Other factors, far more serious and subtle, now merged in the present trade slump, have been silently working during many years, while those responsible for maintaining the industry have not sufficiently anticipated the danger now confronting it.

The lac industry owed its brief prosperity exclusively to scientific developments in Europe and America. Before the advent of the gramophone the demand for lac was very limited, being utilized in a few of the finishing industries. In its very early days, lac was valued more for its scarlet dye than for the resin, and German synthetic dyes soon ousted this natural product, not because of superior fastness or brilliance but by their ready availability to fabrics without elaborate processing. The lac dye lost its market through dearth of economical manufacturing methods, and to-day its significance is only historical.

At that period in this country the resin had a few uses each indicating the potential nucleus of a big industry. Bangle-making could have grown into the moulding trade, later developed in the West; the lacquer industry could have been built up into the manufacture of lacquers and lacquer-enamels for metal and wood; but there existed neither the atmosphere nor the urge to elaborate industries based on the utilization of indigenous raw materials.

The industrial revolution wrought a transformation in the economic life of the Western nations; it gave an incentive into their inventive genius which, in turn, stimulated a greedy hunt for new raw materials from all parts of the globe. India, with her vast wealth and variety of unexploited raw meterials, generously responded to the call. Lac was one of the important raw materials whose production was greatly enlarged by the industrial developments in the West. The expansion of the electrical industry in America, the gramophone industry and the development of the finishing industries in general built up a steady demand for lac. In course of perfecting and rationalizing these industries, lac was subjected to rigorous tests and found wanting. Shellac as a plastic or as an ingredient for moulding compositions did not meet the exacting requirements of certain industries; for instance, although a good electrical insulator at ordinary temperatures, it cannot withstand high temperatures. The demands of industry grew more discriminating and rational, which in turn necessitated the control of the raw material from the very origin of its production. The lac industry was in a primitive state of organization. Frequent failures and uncertainty of crops led to violent fluctuations of the shellac market, which gave the exporter ample opportunity to speculate, thus doing more harm to the industry than any other single factor contributing to its present downfall. There was then no organization in the country to standardise the various lac brands, and ensure that reasonable uniformity of composition which the rationalized industries demand. Uncontrolled and greedy adulterations practised throughout the country brought down the reputation of the product and led to a rigorous system of analysis by the consumer. In short, the Indian industry did not cater sympathetically, intelligently and honestly for the needs of foreign consumers who were driven in disgust to search for synthetic substitutes

fully capable of control. It is the same spirit which induced some of the American manufacturers to lease out their own estates and forests in India for purposes of lac production.

American revolt against the shellac trade tyranny dates from 1910, because it is during this year that L. V. Redman began his investigations of the action between phenols and aldehydes under the auspices of the Mellon Institute. This intensive study, occupying three years, bore fruit in the commercial manufacture of "Redmanol". At the same time, the analogous product called "Bakelite" had been developed by L. H. Bakeland. Later these two processes were amalgamated with such fruitful results as have been witnessed during the last decade and a half. The synthetic resins have played an important part in all recent technological progress. The variety of synthetic resins now available is so great that there is a resin suitable for any rigorous specification that may be imposed. The chemistry of resin manufacture is so advanced and the properties of a material so controlled, that the specific needs of any new industry may be met. Although the synthesis of a resin identical with shellac has not been achieved, the products have advantageously displaced shellac in many of the industries. High temperature electric insulation, infusible mouldings, oil-soluble resins, compositions of varying plasticity, hardness, elasticity, colour and transparency have been rendered possible through the wide range of resins that have been revealed. The synthetic resins are not only displacing the natural products, but have also extended their field of usefulness and have stimulated the development of new processes and manufactures. For example, cellulose base plastics and quick-curing resins have entered the field of gramophone-record manufacture, and novelties in the form of flexible records are forecasted through the employment of these new plastics.

Shellac occupied a prominent position among the raw materials of the finisher and the varnish-manufacturer. The advent of pyroxylin and cellulose acetate in the year 1922 into the field of lacquers attacked both lac and the drying oils. The phenomenal development of the lacquer industry in America since 1923 is doubtless due to the industrial production of cheap solvents made possible through (1) evolution of the butyl alcohol fermentation process and (2) high pressure catalytic synthesis of alcohols. The mass production of automobiles called for quick drying lacquers adapted to rapid spray painting, in place of the old oil varnishes which require to be heat-cured or baked for long hours. The lacquer and lacquer-enamel investigation has been so ardently pursued that the days of oil-varnishes in the linseed class are numbered, their place being taken by partially polymerised synthetic resins. The technological success of these pyroxylin lacquers has been so great and convincing that American railway rolling stock has been painted with them and the total consumption of pyroxylin for lacquers in the year 1929 was 41 million gallons.

In the lacquer industry, shellac, as the chief ingredient of spirit varnishes, has lost its pre-eminent position and is now subordinated to lending gloss, brilliance, hardness with water-proofing and adhesive qualities to the pyroxylin finishes.

Intercommodity and interprocess competition has adversely influenced lac because of high and unsettled prices, variable composition, and incapacity to meet some of the new needs. In 1924, America overproduced synthetic resins and the essential raw materials, of which America has now made herself independent of foreign import. This is a serious situation which gives little hope of recovery for the shellac market, since America would naturally strive to utilize her home-made and abundant synthetics to her best advantage, in preference to shellac which she has to import. If the American demand, which still accounts for sixty per cent. of the trade continues to decline, the lac industry will have to face a ruinous crisis. During the last few months, shellac has found a few new markets in Europe, but compared with what it stands to lose in America, these are negligible.

The remedy to this threatening situation lies not in propaganda in foreign countries extolling the virtues of our raw material but in building up indigenous industries which will consume it in our own country. When Japan's camphor industry was threatened with severe competition from German synthetic camphor, Japan immediately organized her national industry and founded a trust to control the prices. When she found that the economic price could no longer be maintained, Japan founded the celluloid industry which consumes a considerable

part of her natural product. India should now adopt a similar policy with respect to the lac industry. The spirit lacquers and lacquer enamels which consume shellac as the principal ingredient should be manufactured. Intensive research work will have to be undertaken to discover suitable solvents and plasticisers which will impart to the shellac film the desirable qualities of gloss, hardness, resistance to water and to other forms of chemical action. The solvents of shellac as compared with those of cellulose esters are far cheaper and are at present available in large quantities in the country; if necessary, their output could be increased.

The use of shellac could be extended to the manufacture of certain types of mouldings which need not be exposed to high temperatures. Many of the electrical appliances, switches, plugs, etc., with dials, stands and other artware could be manufactured. Much research is required to elucidate the fundamental physical and chemical properties of shellac before we can think of other appropriate uses. In the meanwhile a beginning can be made on the lines indicated.

To encourage exploitation of new uses for shellac, research fellowships and prizes should be founded on a liberal scale in the country and in this matter the Government should help the industry. The Rubber Growers' Association launched a similar scheme a decade ago, as a result of which 10,000 suggestions were put forward for novel uses of rubber. The technology and industrial applications of rubber have benefited immensely as a result of this scheme which has no doubt greatly stabilized a trade at present suffering from overproduction. The Imperial Council of Agricultural Research should immediately take this matter in hand and investigate a situation which bears heavily on the economic prosperity of the country.

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### Effect of Ionization on Impregnated Paper Insulation.

(*Electrical World*, July 30, 1932, Vol. 100, 5.)

MR. K. S. WYATT, Research Department, Detroit Edison Co., has experimentally shown that if ionization occurs in an operating cable, the impregnating compound itself may deteriorate and increase considerably in dielectric loss. The deterioration products may not be uniformly distributed throughout the cable, but may be concentrated in spots which conceivably might factor in breakdown. The modified Becker cell used in the investigations appears to be an effective tool with which to investigate the influence of Corona discharge on the dielectric loss characeristics of insulting oils and papers.

## Science News.

WE have pleasure in acknowledging with sincere and heart-felt gratitude, the generous donation of Rupees Five Hundred granted to the "*Current Science*" Funds by the Senate of the Madras University for 1932-33. May we not hope that this shining example of Madras to uphold and advance the cause of Science in India will be promptly followed by the other Universities?

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In an extension lecture of the Allahabad University, Prof. A. C. Banerji, M.A., M.Sc., addressing on "Modern Science and its influence on some of the Philosophical ideas of the present century", outlined the far-reaching changes brought about in man's outlook of the Universe by modern theories of physical science. The age of the mechanical scientist is gone and the quantum theory, atomic theory and relativity have replaced the law of causation and determinism, whereby Nature could only follow one path, *i.e.*, the road mapped out for her from the beginning of time to its end, by the Law of Probability and Uncertainty. There is no real distinction between aspects of matter or light. It is a case of the principle of duality as suggested by C. G. Darwin. According to the Heisenberg's principle of indetermination, it can no longer be asserted that a complete knowledge of the present would make it possible for us to predict the future with certainty.

Discussing the theory of the expanding Universe as suggested by LeMaitre, DeSitter and Eddington, Prof. Banerji said that it is possible to reconcile the age of the Universe as calculated by Eddington and as obtained from Astronomical and Geophysical evidence by assuming that the reddening of Spectral lines was due to gravitational effect as postulated by Zivicky.

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The following papers were read before the U. P. Academy of Sciences, Allahabad, on the 6th of August 1932:—

1. "On a Generalized Formulation of Trouton's Law". By Mr. Satyendra Nath Ray, M.Sc., Lucknow.
2. "A generalization of a well-known theorem" (Vivanti-Borel-Dienes Theorem). By Dr. T. Vijayaraghavan, D.Phil., Dacca.
3. "On the absorption spectrum of some higher oxides". By Mr. A. K. Dutta, M.Sc. & Mr. P. K. Sen Gupta, M.Sc., Allahabad.

4. "Post dissociation radiation from $SO_3$". By Mr. A. K. Dutta, M.Sc., Allahabad.
5. "Absorption spectrum of irradiated iodine". By Mr. G. R. Toshniwal, M.Sc., Allahabad.
6. "Classification of lines of $Cl_{IV}$ and $Cl_V$". By Mr. Suresh Chandra Deb, M.Sc., Allahabad.

* * *

Pandit Madan Mohan Malaviya, Vice-Chancellor, Benares Hindu University, Benares, has been elected a Honorary Fellow of the Academy for his eminent services in the cause of Science and Education. It has been decided to elect four additional Fellows of the Academy.

* * *

Addressing the South Indian Science Association on "Ordinary and Alloy Steels", Mr. D. V. Krishna Rao, Metallurgist, Bhadravati Iron Works, referred to the importance of the Iron and Steel Industry quoting the words of Sir George May, "We are satisfied that the maintenance of a prosperous Iron and Steel Industry in the highest degree of efficiency is essential to the economic progress of this country, while from the point of view of national security it must still be regarded as vital. We accept, therefore, the preliminary proposition that this industry shall be adequately protected and protected at once."

Reference was made to the experiments conducted at Bhadravati in a small Bessemer Converter and an electric furnace. Experiments on ferrochrome conducted at Bangalore showed the great possibilities of ferrochrome in the manufacture of alloy steels.

* * *

Mr. S. S. Patwardhan writes to inform us that he is engaged in the investigation of the anatomy of the common fresh water prawn occurring in Nagpur. He has completed the study of the external characters and parts of internal anatomy and hopes to be able to publish a full report of his researches at an early date.

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H. H. The Maharaja of Travancore Curzon Prize for 1932, of the value of Rs. 500, has been awarded by the University of Madras to Mr. S. Ranganathan, B.A., M.Sc., A.I.I.Sc., Nutrition Research Laboratories, I.R.F.A., Coonoor, for his thesis entitled: "Urinary Calculus — A Problem in Physiological Chemistry."

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We have received one of the Chemical Slide Rule No. 33 manufactured by Albert Nestler AG. The Slide Rule is intended for the use of students of chemistry and besides multiplication, division, evolution and other features of ordinary Slide Rules, it enables special chemical calculations such as analysis, gas reductions, strength and efficiency of currents, etc., by means of molecular and atomic weight scales. We have found the Slide Rule very handy in the laboratory and recommend it to all research workers who have any calculations to make. The Slide Rule is priced at Rs. 10 each and can be had from the Indian Agents, Messrs. M. N. Gokli, Matunga, Bombay, whose advertisement appears elsewhere in this issue.

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The Microid physical series of apparatus illustrated and described in Catalogue No. 115 of Messrs. Griffin and Tatlock, Ltd., England, is indeed a marked advance in laboratory supplies. Not only are the apparatus, many of them of substantial and original design described, but the actual experiment and calculations of results obtained are set out. This is a very welcome feature that should go a long way to popularize these range of apparatus in many laboratories. The apparatus described covers a whole range of subjects simplified, mechanical equivalent of heat apparatus, precision expansion apparatus using invar supporting rods. The thermo-magnet, magnetic potentiometer, refractometer are some of these interesting apparatus which every laboratory worth its name should have.

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We acknowledge with thanks the receipt of the following:—

"Quinquennial Review on the Progress of Education in India", Vols. 1 and 2, 1922-27. Government of India Central Publication Branch, Calcutta.

"Annual Report on Education in India", 1929-30. Government of India Central Publication Branch, Calcutta.

"India in 1930-31", Director of Public Information, Simla.

"Indian Forester", September 1932.

"Scientific Indian", September 1932.

"Journal of the Chemical Society", Vol. IX, No. 1-7, January—July 1932.

"Journal of the Indian Mathematical Society", Vol. XIX, No. 9.

"General Catalogue of Standard Works", Charles Griffin & Co., Ltd., London.

Catalogues of Messrs. Carl Zeiss, Schott & Gen, Jena, Hartmann & Braun AG Frankfurt, from Messrs. Adair Dutt & Co., Ltd., Calcutta.

Catalogue No. 115X—Microid Physical Series from Messrs. Griffin & Tatlock, Ltd., Calcutta.

## Reviews.

*Palæontologia Indica*, New Ser., Vol. XVIII. The Fossil Carnivora of India. By G. E. Pilgrim, D.Sc., F.G.S., F.A.S.B. Pp. iv+232+10 plates. (Calcutta: Geological Survey of India, 1932.)

Compared with the wealth of extinct species belonging to the other order of mammals which occur in the Upper Tertiary freshwater deposits of India, the fossil carnivora are rather scantily represented in this formation. The first notice of the fossil remains of carnivorous mammals from the Siwalik deposits of India appeared just over a century ago from the well-known collectors of fossil vertebrate remains, Falconer and Cautley. In 1880, Mr. P. N. Bose described some types of Siwalik cat, hyæna and dog from the original collections in the British Museum and in 1882, Lydekker wrote a monograph in which he described all the known

Siwalik and Narbada carnivores. Our knowledge of the Siwalik mammals in general, and of the carnivores in particular, has since then been considerably enriched by the work of Dr. G. E. Pilgrim, who has, since 1910, assiduously and systematically collected from the well-known ossiferous deposits developed in the Salt Range area, the Hosiarpur and Kangra districts and from Bugti Hills of Baluchistan. The results of his work have been published in the *Palæontologia Indica* in a series of memoirs on the Giraffidæ, the Suidæ, the Primates, the vertebrate fauna of the Bukti Hills and the Eocene Perissodactyla from Burma. The present memoir on the Carnivora is by no means the last, for one on the Cavicornia of India is under preparation.

Dr. Pilgrim's present contribution forms a valuable summary of our knowledge of the Siwalik Carnivores, of their affinities, inter-continental migrations, lines of descent and suggested phylogenies. It is unfortunately true that a large part of the fossil material embedded in the Siwalik formation suffers from an unsatisfactory mode of preservation and generally is of a highly fragile and fragmentary nature; the discovery of complete jaw-bones, skulls and even of perfectly preserved limb-bones being rather rare events. This is happily not strictly the case with the collection described by Dr. Pilgrim in the memoir under review, for there are fourteen skulls (though only two are figured here) in various degrees of completeness, together with a fair number of maxillæ and mandibles, though, as usual, the greater part of the material available for study is in the form of molars, premolars and canines, either loose or embedded in small fragments of jaw-bones. It must have needed a wide knowledge of anatomical and morphological details to attempt to reconstruct the dentition and the cranial features of the extinct owners of these fragmentary relics.

Only two Creodont species (primitive, ancestral carnivores) have been found, preserved in the Chinji stage of the Lower Siwalik; the rest of the large number of species described here belong to the modern living families of Canidæ, Ursidæ, Mustellidæ, Viverridæ, Hyænidæ and Felidæ, occurring, for the most part, in the Dhok Pathan (Pontian) stage of the Middle Siwalik or the Pinjor (Upper Pliocene) stage of the Upper Siwalik. The earliest Indian carnivores hitherto discovered come from the Gaj series (Burdigallian stage) of the Bugti Hills. These are ascribed to three species belonging to the primitive cats and dogs.

The Hyænidæ are well represented in the Indian region in the later Tertiary deposits and the occurrence of at any rate certain branches of the family at an earlier horizon than is the case in Europe, sheds some light on the lines of descent. The author gives a suggested phylogeny of the hyæna family from the time this group branched off from the Viverridæ.

The plates, reproduced from photographs and drawings by the Geological Survey of India, are of the usual standard. There is an excellent bibliography and a palæontological index.

D. N. W.

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*Fundamentals of Biology*. By A. W. Haupt, Ph.D., University of California. Pp. x, 403. (McGraw Hill Book Co., Inc., New York and London.) Price 18*s*.

Prof. Haupt in bringing out his second edition of *Fundamentals of Biology* richly deserves congratulations, for it serves as a guide not only to the student of Biology in the College classes but to every public-minded citizen as well. It is generally accepted that in the discharge of one's civic responsibilities one ought to have a sound biological mental equipment which alone can give the right perspective to one's duties and obligations. The object of this book is two-fold. It aims at the cultural development and at the same time provides a large variety of useful and correct information to students preparing for examination. In the earlier chapters the book deals with the morphological characters of the lower and higher animals and plants. Two chapters are devoted to a consideration of the invertebrates while in a further chapter the frog is chosen as a type for a detailed treatment as an introduction to vertebrate morphology. Cursory references to the other groups of the vertebrates are also made. We should have certainly liked a more comprehensive account of the mammals and also a good account of any social insect,—the ant or the honey bee,—for, possibly from one of these well-organized societies, man draws his inspiration for communal life.

The chapters on general principles of Biology, such as heredity, the Mendelian principle and the facts and causes of Evolution,—form valuable and readable additions

to the book, in which the author has endeavoured to give a very clear and comprehensive idea of these very interesting facts of Biological Science. Palæontology, that branch of Biological Science which is most essential for its complete understanding, is treated with great clarity and conciseness. The history of the ancestry of man forms a fit concluding chapter to this excellent book. The illustrations, we are glad to mention, are carefully chosen and excellently reproduced. The style of presentation leaves nothing to be desired. We are of opinion that the book can be used with considerable advantage by students studying Biology and we should recommend that it may be added to the libraries of all secondary schools and colleges.

L. S. R.

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*The Pelecypoda of the Siboga Expedition.* By B. Prashad, Zoological Survey of India. (Monograph LIIIc, 334 pp., 9 pls., Leiden, 1932, with a chart of the track of the "Siboga" Expedition.)

The present work is the last of the series dealing with the Bivalve molluscs of the Indo-Pacific seas collected by the "Siboga" Expedition under the leadership of Dr. Max Weber. It includes a more or less complete systematic account of all the families of Pelecypoda except the Pectinidæ. Out of over 400 species and varieties of Bivalve molluscs brought back by the Expedition nearly a fourth represents the forms new to Science which are carefully described and their affinities with known forms are indicated. The excellent photographs and drawings illustrating the salient features of not only the new forms but also of the little known species leave nothing to be desired. The exhaustive synonymic lists and the notes on the distribution and affinities of known species add greatly to the value of the work. There is also a useful index of genera and species at the end. The author deserves the thanks of all students of marine Pelecypoda for an important work of reference on the Indo-Pacific forms.

H. S. R.

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*The Tailless Batrachians of Japanese Empire.* By Yaichiro Okada. (Imperial Agricultural Experiment Station, Tokyo, Japan: 1931). Pp. 215, with 29 plates and 97 text-figures.

Dr. Okada's memoir is one of the most beautifully illustrated publications on Batrachians published in any country. The author in addition to describing in great detail as many as fifty-nine species and sub-species of tailless Batrachians which occur in the Japanese Empire, has discussed in some detail the geographical distribution and the faunal elements in the Batrachians of Japan. Further, in addition to the descriptions of the external characters of the different species, detailed accounts about skeletal peculiarities are also included in the memoir.

B. P.

## Coming Events.

### Scuth Indian Science Association.

(CENTRAL COLLEGE, BANGALORE.)

21st Oct. 6 P.M.
"Liquid Air", by Mr. G. Gundu Rao, M.Sc., A.I.I.Sc., Indian Institute of Science, Bangalore.

31st Oct. 6 P.M.
"The Development of the Modern Transformer", by Mr. Vokkaleri Rama Rao, B.Sc., Transformer Expert to the Government of Mysore.

11th Nov. 6 P.M.
"Ancient Hindu Astronomy", by Mr. K. Amrita Rao, M.A., L.T., Librarian, Indian Institute of Science.

## Errata.

"*Current Science*", *Vol.* 1, *No.* 2, *August* 1932.

Page 36, Column 2, Line 21, *for* "Latin Square Method" *read* "Checker-board Method".

Page 38, Column 1, Line 47, *for* "decrease" *read* "increase".